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The Macroeconomics of the Public Sector Deficit

The Case of Colombia

William Easterly

There is a close relationship between the means of financing the fiscal deficit and macroeconomic outcomes in Colombia. A debt-financed deficit increase of about 1 percent of GDP translates into a real interest rate increase of 3 to 5 percent; a money-financed deficit increase of about 1 percent translates into 15 percentage points more inflation.

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This paper — a product of the Macroeconomic Adjustment and Growth Division, Country Economics Department — is part of PRE research project, The Macroeconomics of the Public Sector Deficit (RPO 675-31). Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Raquel Luz, room N11-057, extension 39059 (97 pages).

Colombia is justly celebrated in Latin America for its prudent macroeconomic management, the cornerstone of which is careful management of fiscal deficits.

From the 1960s through the early 1970s, Colombia's macroeconomic policy was mostly conservative — supportive of an export-oriented development strategy associated with high growth of both GDP and trade. Authorities were partially successful at steril- 'ng a surge in coffee export revenues in the second half of the 1970s. In the early 1980s, the end of the coffee boom coincided with a large increase in public investment — especially in energy — which led to an incipient balance of payments and debt crisis. This crisis was largely avoided through a strong, continuing adjustment effort that began in 1985.

Episodes of loose fiscal policy in Colombia have been minor compared with other Latin American countries. The crisis of the early 1980s was cut short by a sharp fiscal adjustment. This adjustment was a combination of good luck and fundamental policy changes, especially the latter. To restore long-term growth, some fiscal reform will be needed to reverse some measure implemented between 1985 and 1989.

Easterly finds a close relationship between the means of financing the fiscal deficit and macroeconomic outcomes in Colombia. Using a simulation model, he traces how money-financed and domestic debt-financed fiscal deficits translate into inflation and the real interest rate.

Roughly speaking, a debt-financed deficit increase of about 1 percent of GDP translates into a real interest rate increase of 3 to 5 percent; a money-financed deficit increase of about 1 percent translates into 15 percentage points more inflation.

Easterly finds that many changes in the real exchange rate between 1975 and 1987 are attributable to fiscal policy. He shows how external debt financing and domestic debt financing have relatively different effects on the real exchange rate and the real interest rate.

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I. INTRODUCTION

This paper analyzes the macroeconomic effects of public sector deficits in Colombia, using the methodology set out in the research proposal.[1] The first section will review the historical evolution of fiscal policy in Colombia, with an emphasis on the adjustment program of 1985-89. Since the fiscal deficit is particularly sensitive to developments in the coffee sector, a section looks at how much of the public coffee balance is explained by exogenous shocks. The next section examines how fiscal deficits affect the inflation rate and the real interest rate, using an econometrically-estimated model of the money and credit markets. The following section discusses the relationship between the fiscal deficit and the real exchange rate, using a reduced form model of traded and nontraded goods. The concluding section puts together the models of the preceding sections to look at the simultaneous determination of the real exchange rate and the real interest rate in response to fiscal policy changes.

II. HISTORICAL BACKGROUND

Colombia is justly celebrated in Latin America for its prudent macroeconomic management, of which careful management of fiscal deficits is the cornerstone. Even the occasional departures from conservative macroeconomic policy seem tame by Latin American standards. We will review the broad outlines of macroeconomic policy in this section. In the following section, we will look in more detail into the adjustment that has taken place since 1985.

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[1]Easterly, W., K. Schmidt-Hebbel, and C. Rodriguez, "The Macroeconomics of Public Sector Deficits", March 1989.

1. Macroeconomic Management, 1960-89

A very brief synopsis of Colombian macroeconomic policy will help to introduce this section (see Garcia (1988) for a more detailed review). Table 1 shows some basic macroeconomic indicators. From the mid 1960's through the early 1970's, macroeconomic policy was mostly conservative, supportive of an export-oriented development strategy that was associated with high growth of both GDP and trade. The main factor in the second half of the 1970's was the surge in coffee export revenues, which the authorities were partially successful at sterilizing. In the early 1980's the end of the coffee boom coincided with a large increase in public investment--especially in the energy sector--which led to an incipient balance of payments and debt crisis. The crisis was largely avoided thanks to a strong adjustment effort beginning in 1985 and continuing to the present.

Figure 1 presents a historical perspective on fiscal management. The only series available for a sufficiently long period is the IFS series on the national government deficit, which is not consistent with the fiscal data used elsewhere in this report but does show a similar pattern. We see there have been 3 episodes of loose fiscal policy at roughly ten-year intervals--in 1961-62, in 1972-73, and 1981-84, of which the last is by far the most severe. Each was followed by rapid fiscal adjustment that avoided a prolonged crisis. The impression of careful macroeconomic management over a long period is confirmed.

The impression of relative macro stability is confirmed by the behavior of the inflation rate, as shown in figure 2. By Latin American standards (although not by world standards) the rate is very stable, staying within a band of roughly 15 to 35 percent since the early 1970's. We see roughly 3 distinct periods. (1) During most of the 1960's, inflation oscillated

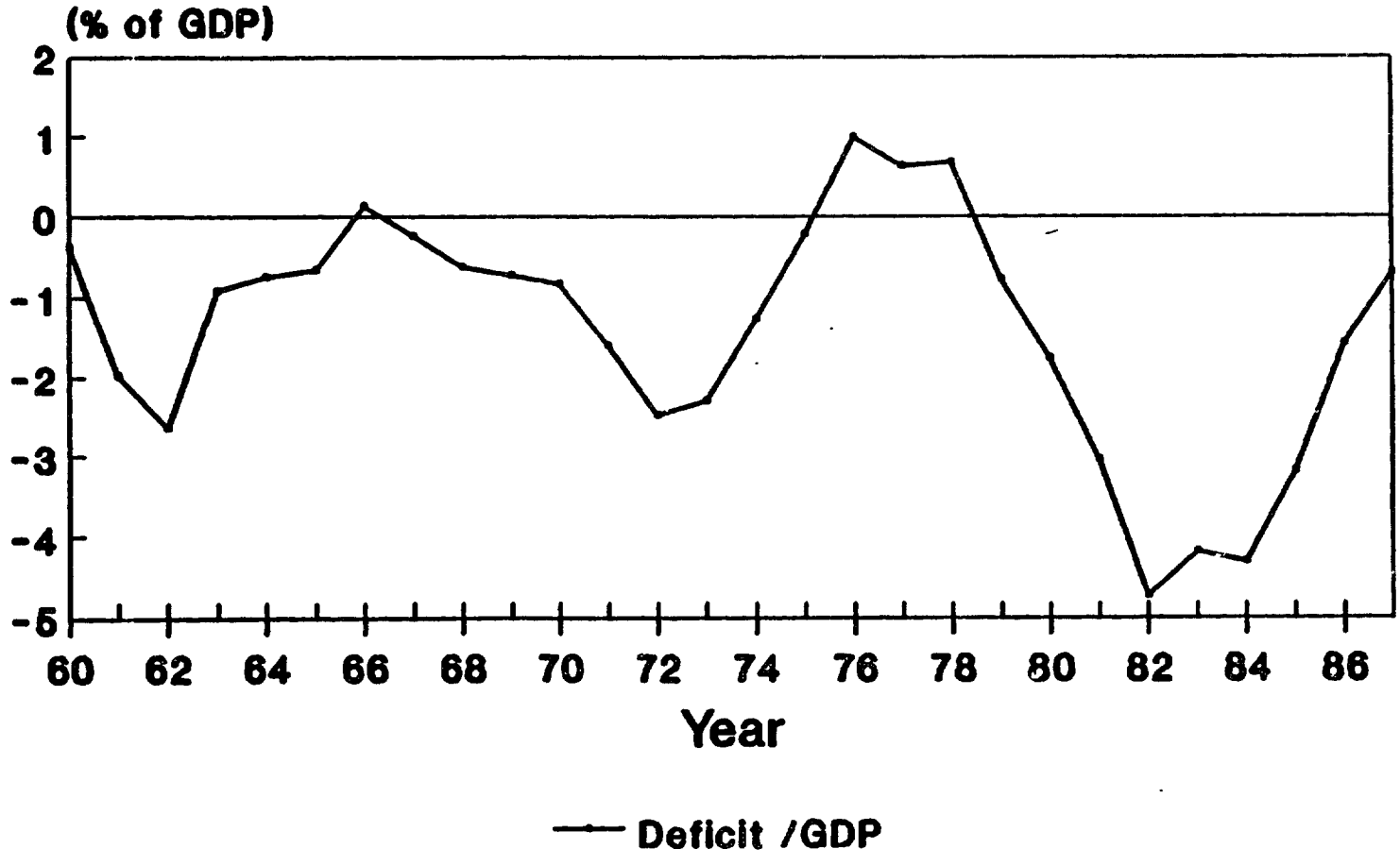
COLOMBIA
Table 1: Basic Economic Indicators

	Five Year Averages					
	1960-65	1965-70	1970-75	1975-80	1980-85	1985-89
Real Exchange Rate 1/	99.73	112.79	129.85	128.26	118.45	161.40
Inflation Rate	11.08	9.25	16.87	24.17	23.12	24.04
Fiscal Balance/ GDP 2/	-1.22	-0.49	-1.45	-0.08	-3.54	-1.82
Fiscal Balance/ GDP 3/				-2.08	-5.80	-2.60
Fiscal Balance/ GDP 4/	-2.17	-1.77	-2.88	-1.53	-5.73	
Real Interest Rate:						
On Loans			2.43	4.40	10.30	13.00
On Deposits			-2.20	-1.00	4.31	6.06
GDP Growth	4.71	5.99	5.68	5.35	2.25	3.58
Curr Acct Balance/ GDP	-2.30	-2.70	-2.79	0.62	-5.07	-1.12
Real Priv Inv/ Real GDP	11.85	10.24	9.25	8.14	7.41	8.21
Pub Ext Debt/ GDP 3/			19.98	15.27	22.56	37.16
Pub Ext Debt/ XGS 5/			124.08	79.30	182.99	187.66

1/ Depreciation is up.
2/ International Financial Statistics Yearbook 1989 (National Government only); data until 1987 only.
3/ World Bank project.
4/ J. Garcia-Garcia. "Macroeconomic Policies, Crisis and Growth in the Long Run: Colombia Country Study." May 1988.
5/ World Debt Tables; Public external debt data until 1988 only.

Figure 1

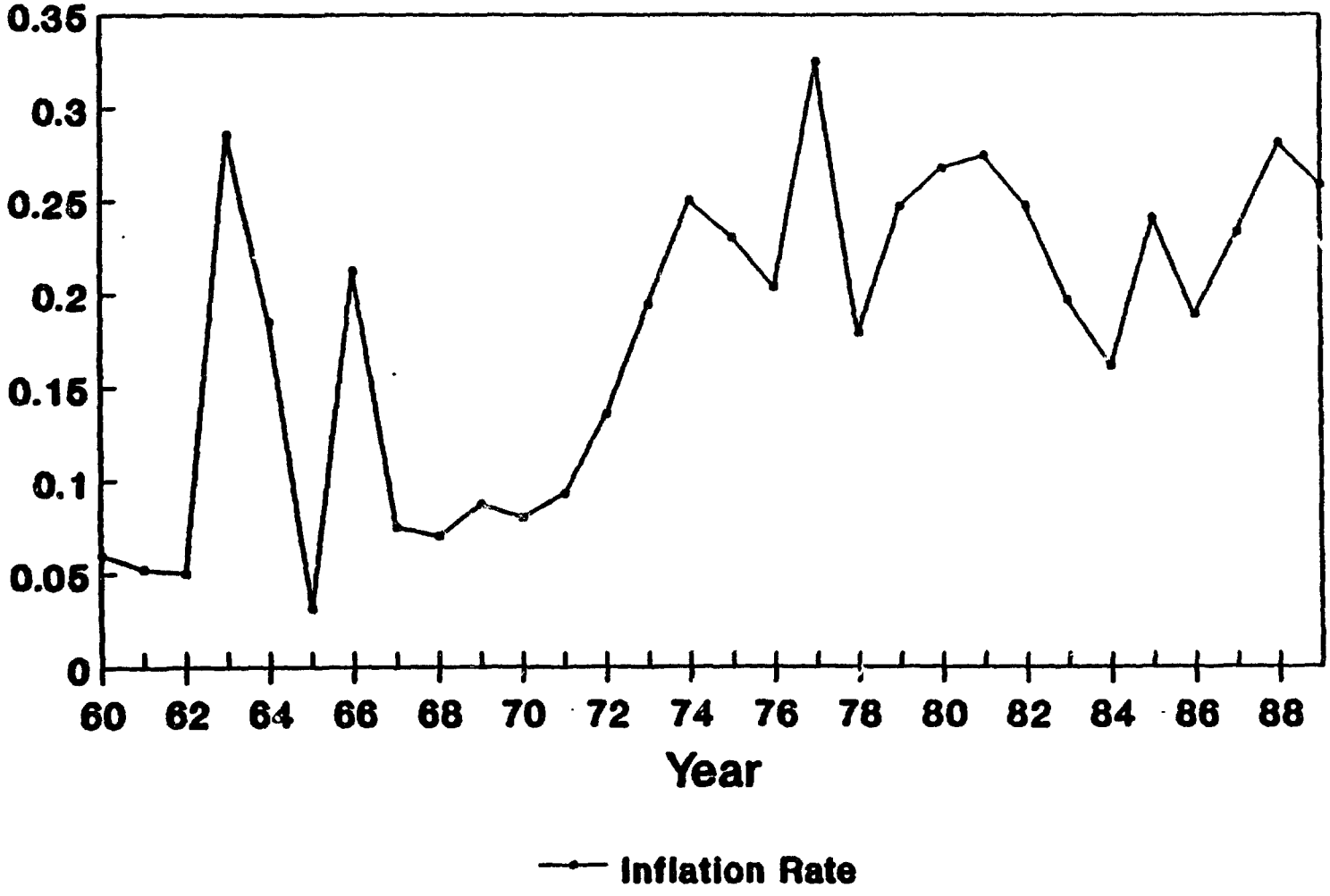
COLOMBIA:
Nat'l Gov't Deficit (% GDP) 1960-87



Source: IFS Yearbook, 1989.
Deficit (-), surplus (+)

Figure 2

COLOMBIA: Inflation Rate 1960-89



in response to periodic large adjustments of the exchange rate. (2) Following the introduction of the crawling peg in 1967, the inflation rate stayed very stable for about 5 years. (3) After the episode of loose fiscal policy in 1972-73, inflation accelerated. It stayed over 20 percent after the coffee boom resulted in some monetization of reserve inflows. After the end of the coffee boom, the fiscal expansion replaced reserve inflows as a source of money creation. Subsequent fiscal contraction was just sufficient to match the reduction in external credit availability during the debt crisis, so that the need for money creation continued.

Figure 3 shows the evolution of money creation, roughly defined as the change in base money over GDP. We see that the reliance on seignorage has been remarkably stable since the mid-60's, aside from a burst of money creation associated with the coffee boom in the late 1970's.

The behavior of the real exchange rate mirrors changes in macro policies, as shown in figure 4. The exchange rate was quite volatile in the early 60's, but after the introduction of the crawling peg it shows a steady depreciation (depreciation is up). This was reversed by the coffee boom after 1975, after which the real exchange rate appreciated steadily until the early 1980's. During the adjustment effort beginning in 1985, the real exchange rate once again depreciated substantially. We see some association between the behavior of the real exchange rate and the episodes of fiscal contraction and expansion. The greatest appreciation of the currency came during the periods of expansionary fiscal policy in the early 60's and early 80's. The episode of loose fiscal policy during the early 70's, on the other hand, did not seem to have much effect. We will examine in a subsequent section the relationship between deficits and the real exchange rate.

Figure 3

COLOMBIA:
Seignorage 1960-88

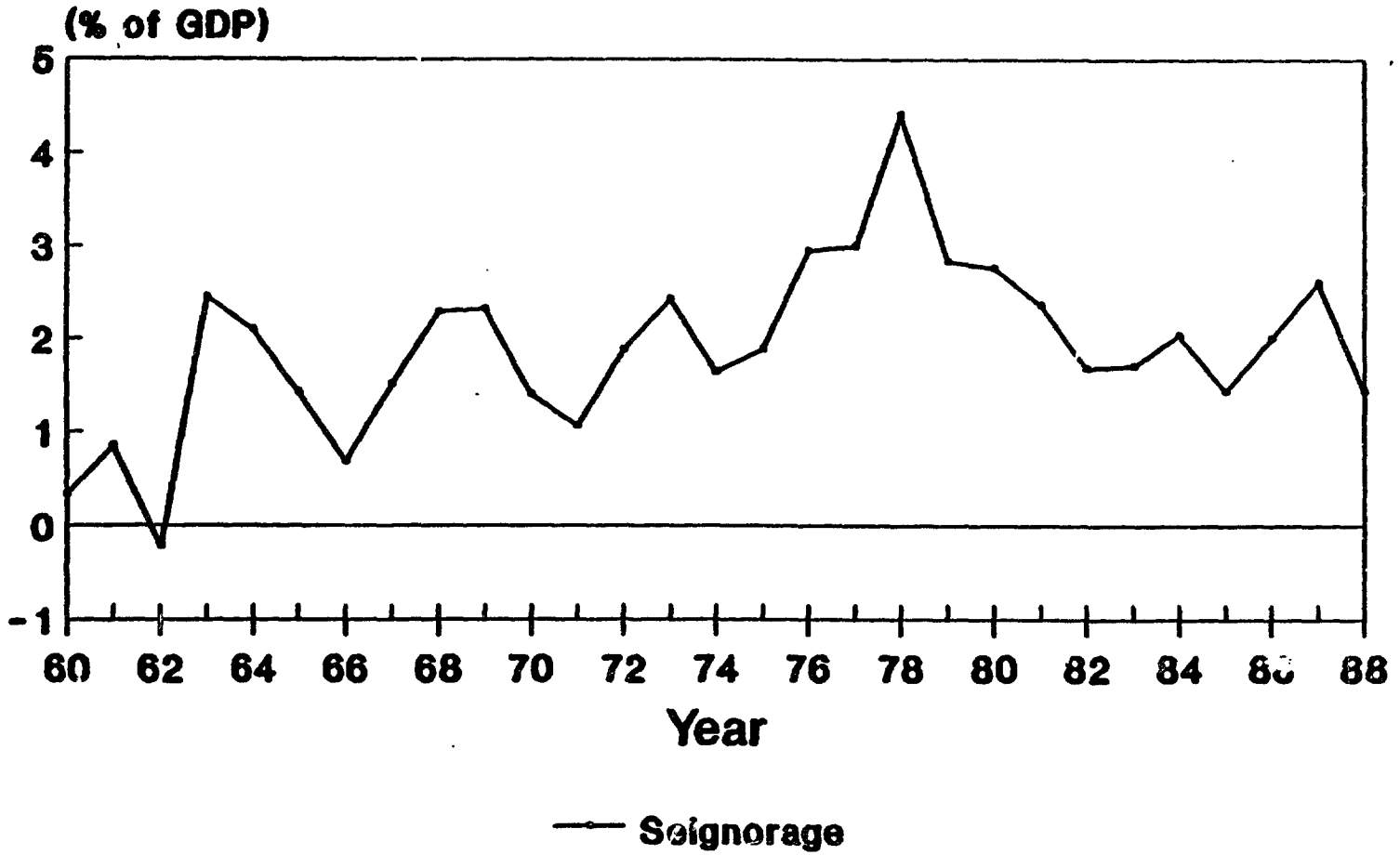
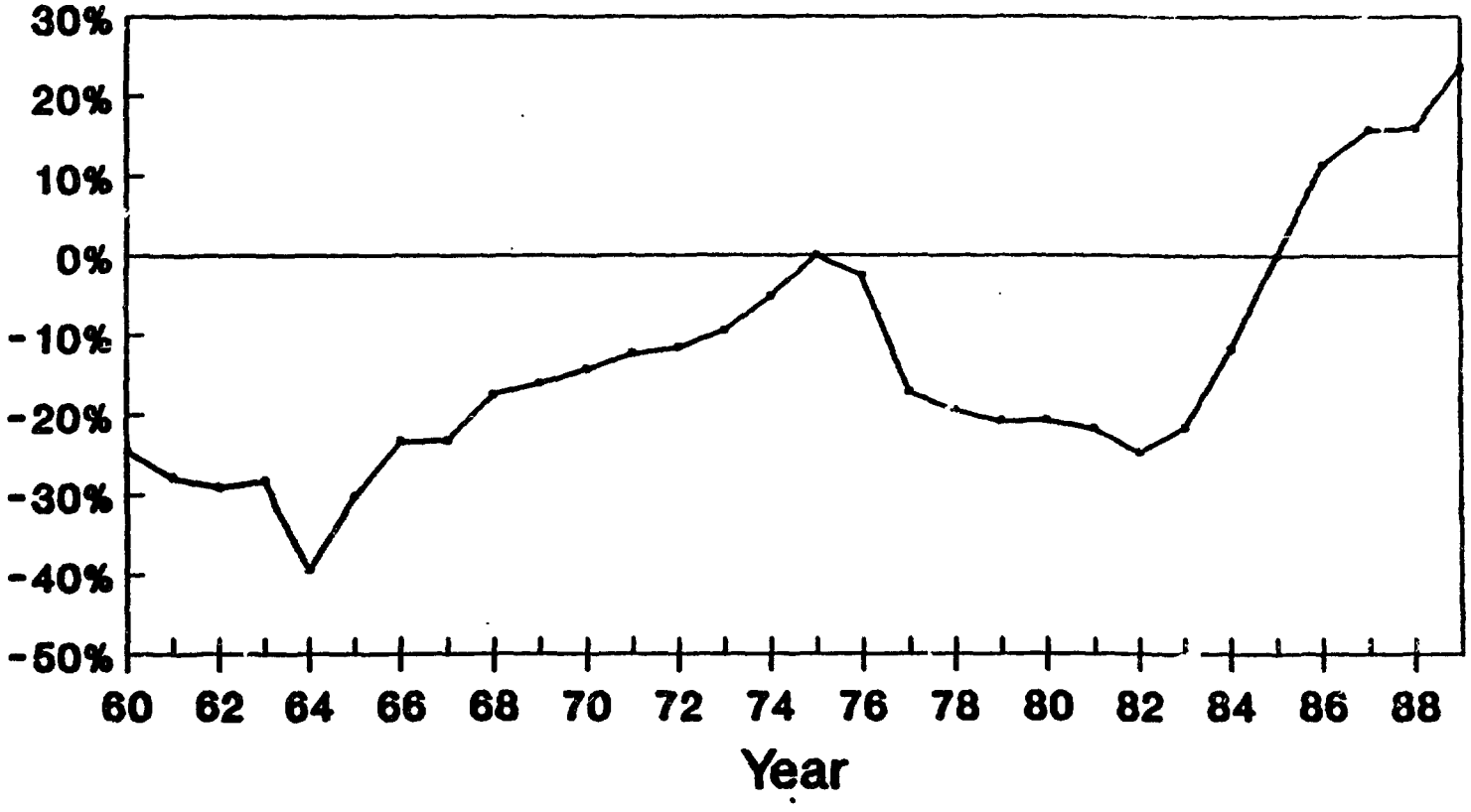


Figure 4

COLOMBIA:
Real Exchange Rate, 1960-89



• % deviation from 1975 value.

The real interest rate shows a more erratic path than inflation and the real exchange rate, as shown in figure 5. This reflects the controls on interest rates prior to 1974, after which began a process of financial liberalization in fits and starts. Interest rates have been mostly market-determined during the 1980's, with occasional temporary controls such as those imposed in 1988. The fiscal expansion of the 1980's was associated with some rise in the real interest rate, although the interest rate remained high even after the fiscal adjustment.

A puzzle of macroeconomic behavior in Colombia is the long-term decline in the private investment ratio, as shown in figure 6. This is defined in real terms to avoid any relative price effect. As seen in the graph, the fiscal adjustment of the first half of the 80's was associated with a decline in investment, while the adjustment program of 1985-88 was associated with a rebound of private investment. The fall in the later 1970s and early 1980s was associated with high real interest rates (figure 5) and a high relative price of capital goods (figure 7). But this was modest compared to the secular decline in investment. The reasons for this may not be macroeconomic ones; the long-run increase in political and drug-related violence could be another explanation (although violence was also endemic in the 1950's). This study will address the behavior of investment in the short run, but will not address fully the causes of the secular decline.

Figure 5

COLOMBIA:
Real Deposit and Loan Rate, 1970-87

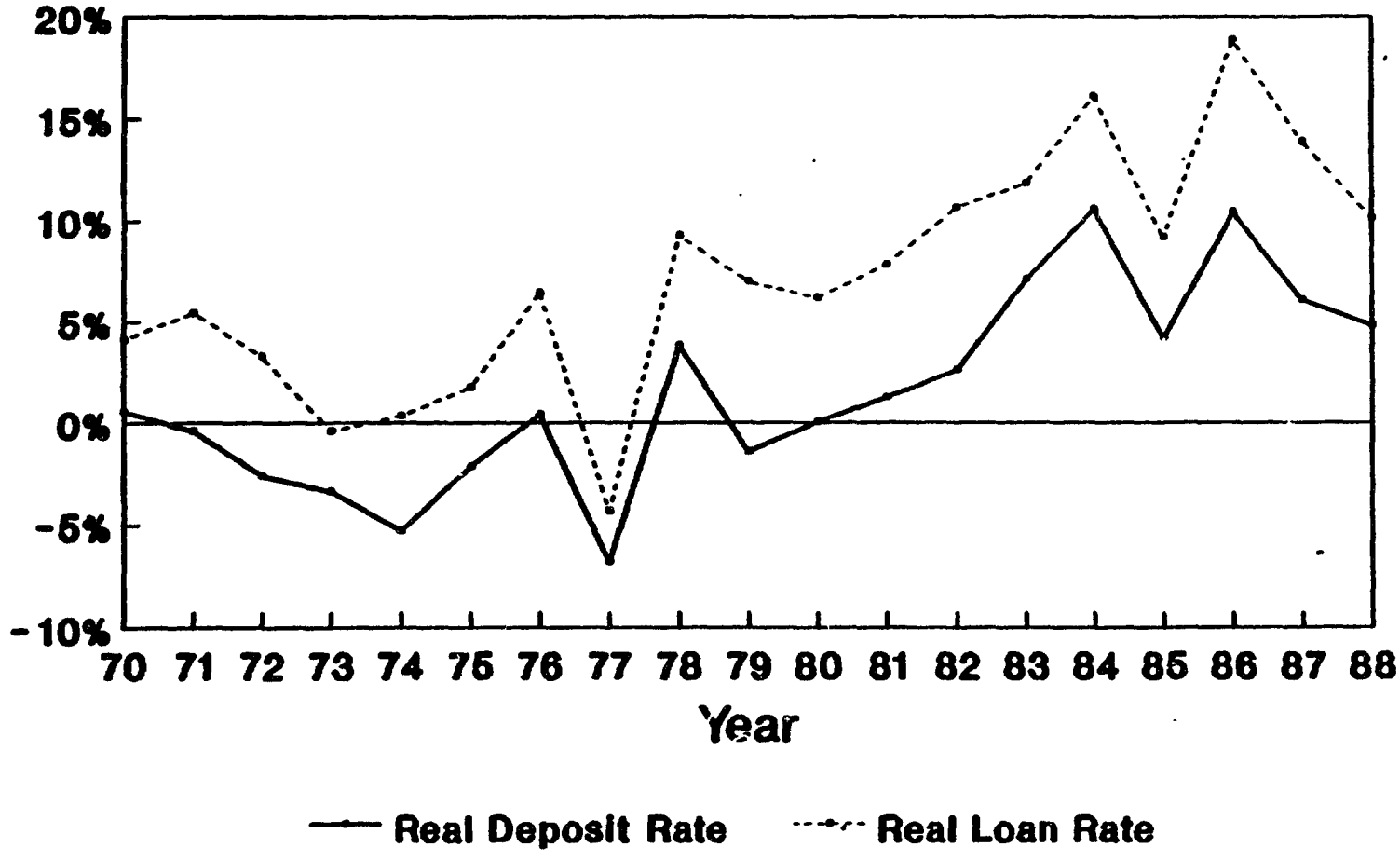


Figure 6

COLOMBIA:
Real Priv Investment (% GDP) 1950-88

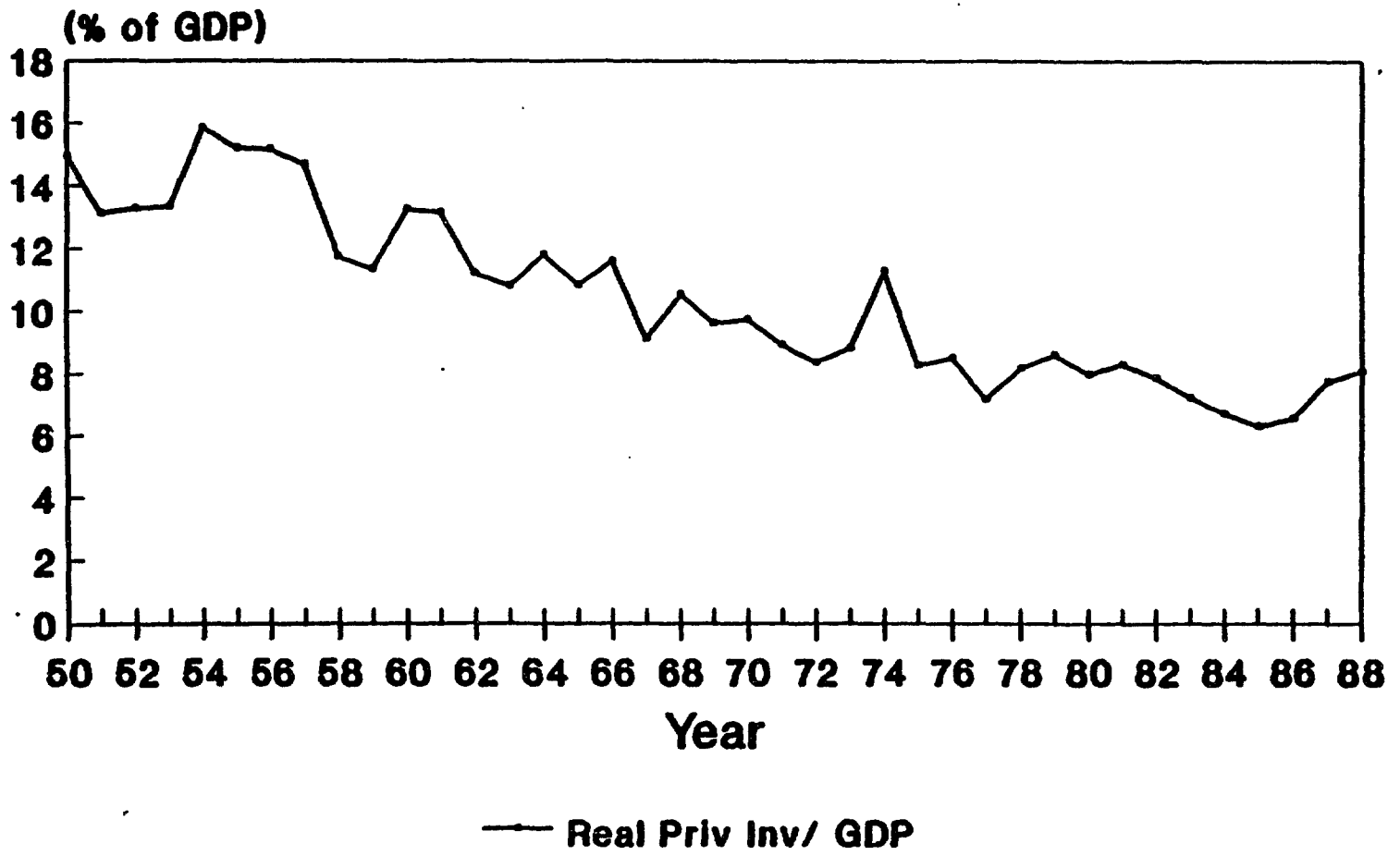
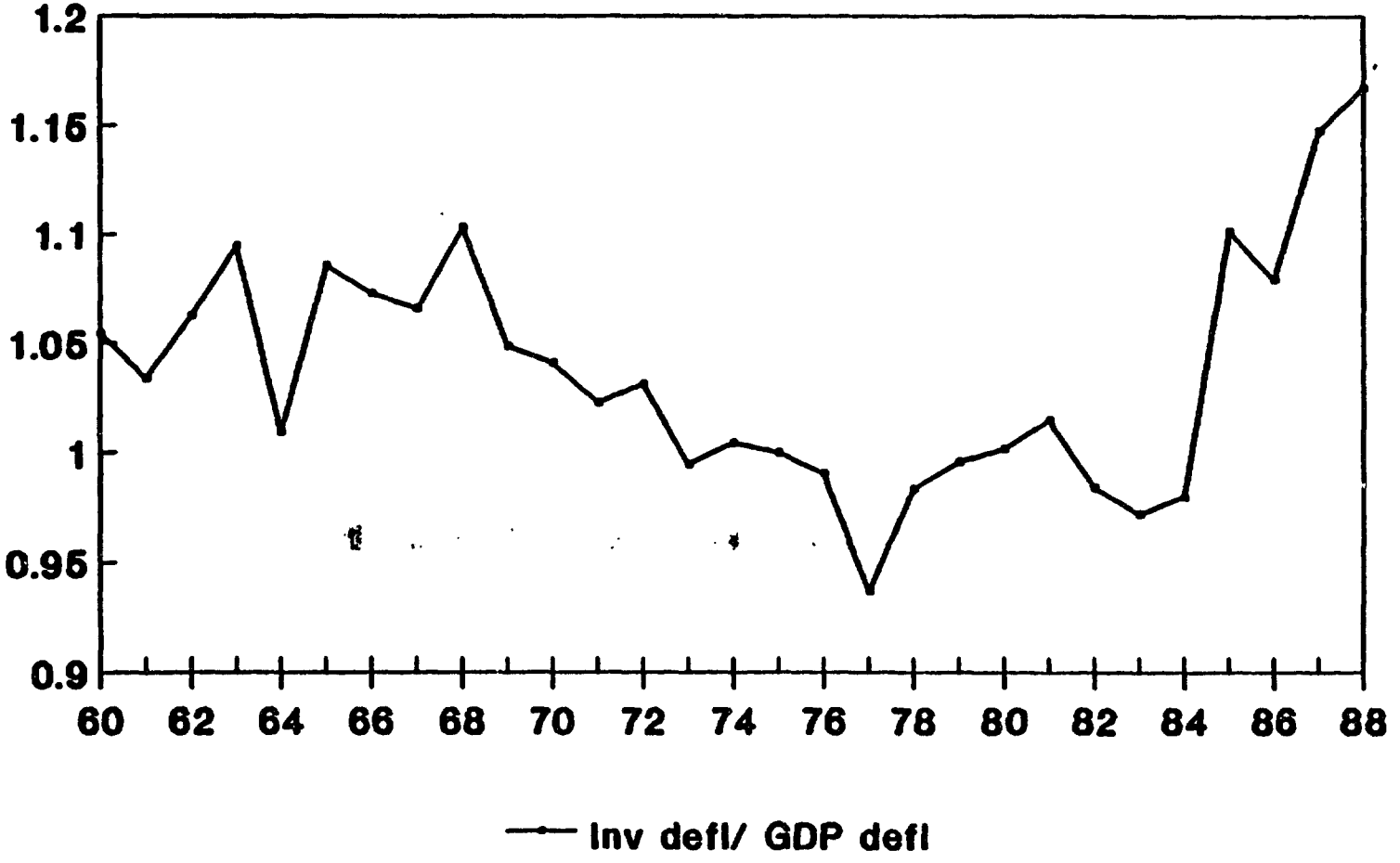


Figure 7

COLOMBIA: Ratio of Investment Deflator to GDP Deflator, 1960-88



COLOMBIA

Table 2: Fiscal Account Summary, 1975-87

Consolidated Non-Financial Public Sector

(As % of GDP - current pesos)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Total Revenue	24.10	23.72	24.28	25.56	24.13	27.55	24.73	29.04	28.15	29.26	29.95	34.21	31.04
Current Revenue	23.43	23.11	23.93	25.20	23.26	24.81	21.79	22.81	24.77	26.90	27.38	32.52	29.02
Taxes	12.67	14.08	13.58	15.95	13.41	14.74	12.92	11.93	13.11	13.07	13.89	14.94	14.60
Nontax	5.93	4.41	5.43	4.41	5.95	5.71	4.70	6.11	4.85	9.10	9.20	13.18	9.93
Other	4.82	4.62	5.00	4.83	3.89	4.35	4.16	4.47	6.81	4.73	4.28	4.39	4.77
Capital Revenue	0.67	0.61	0.27	0.36	0.87	2.75	2.94	2.26	1.05	2.36	2.57	1.70	1.83
Total Expenditure	27.06	24.80	25.90	24.67	28.93	30.24	31.19	31.77	33.59	35.63	34.34	34.73	32.86
Current Expenditure	18.55	15.75	18.41	20.84	19.26	20.37	19.55	19.99	22.05	23.20	21.96	23.59	22.71
Wages & Salaries	7.00	6.49	6.17	6.33	6.82	5.29	5.45	6.41	6.53	2.80	5.02	4.80	4.71
Goods & Services	1.72	2.12	1.86	2.21	2.02	2.19	2.09	2.86	2.89	1.16	2.19	2.04	1.96
Interest Payments	1.00	1.16	1.15	1.27	1.31	1.88	1.62	2.00	2.13	3.40	3.34	3.72	4.55
Domestic	0.31	0.47	0.39	0.58	0.58	0.56	0.50	0.57	0.48	1.31	1.08	0.99	1.18
External	0.69	0.68	0.76	0.69	0.73	1.32	1.11	1.43	1.65	2.08	2.26	2.73	3.37
Current Transfers	7.75	5.58	7.94	9.73	7.45	10.55	8.55	8.15	7.84	9.42	8.84	9.04	9.10
Other Expenditures	1.08	0.40	1.29	1.32	1.66	0.46	1.85	0.47	2.66	6.43	2.57	4.22	2.60
Capital Expenditure	8.30	9.01	7.44	3.98	9.52	9.76	11.50	11.84	11.55	12.40	12.69	11.08	10.50
Gross Fixed Capital	5.34	6.38	4.90	4.52	7.01	6.24	7.65	7.94	7.07	8.89	8.70	7.91	7.27
Capital Transfers	2.43	2.04	2.04	-1.03	1.93	2.58	2.87	2.95	2.39	2.31	2.55	2.19	2.60
Other Capital Payments	0.53	0.58	0.49	0.49	0.58	0.97	0.98	0.96	2.09	1.20	1.43	0.99	0.63
Net Lending	0.20	0.08	0.05	0.05	0.15	0.08	0.14	0.10	0.02	0.47	0.12	0.53	0.17
Tot Deficit(-)/ Surplus	-2.96	-1.08	-1.62	0.89	-4.81	-2.68	-6.45	-7.01	-7.44	-6.37	-4.82	-1.25	-2.50
Curr Deficit (-)/ Surplus	4.87	7.35	5.52	4.36	3.99	4.53	2.25	2.68	2.75	2.79	5.41	8.67	6.49
Total Financing	2.96	1.08	1.62	-0.89	4.81	2.68	6.45	7.01	7.44	6.37	4.82	1.25	2.50
Domestic Financing	-0.09	0.77	0.75	1.41	0.65	1.80	2.53	4.10	5.13	5.12	1.54	0.41	1.88
External Financing	1.36	1.43	0.96	1.08	2.40	2.02	3.28	2.95	2.08	2.49	2.93	4.52	0.22
Other *	1.68	-1.13	-0.09	-3.18	1.75	-0.94	0.64	-0.04	0.23	-1.24	0.36	-3.68	0.40

* Residual of total financing less domestic and external.

2. Public Sector Accounts, 1975-87

Table 2 shows the evolution of the consolidated nonfinancial public sector accounts from 1975-87.[2] The deficit is under control except for the years 1981-84. Deficits were small during the heyday of the coffee boom 1975-78. The end of the coffee boom brought increased deficits, which worsened in 1981-84 because of a surge in public capital spending. The fiscal adjustment beginning in 1985 took place through a reversal of the increase in capital expenditure and an increase in taxes. It was helped by another small coffee boom in 1986 that increased nontax revenues.

We can get some idea as to how the fiscal crisis of the early 80's developed by separating out the effects of changes in coffee revenues and public capital spending, the two largest single influences on the deficit. Figure 8 shows the deficit under alternative assumptions about the behavior of the coffee surplus and public investment. If we hold public capital spending constant at its 1975 value (with the coffee surplus still taking its actual values), we see that no fiscal problem would have developed. On the contrary, the deficit would have remained relatively constant until 1982, then steadily declined until a large surplus was registered by 1987. This suggests that expanded public capital spending played a large role in the appearance of fiscal imbalances in the early 80's. It also implies that adjustment in other items in the fiscal balance besides capital spending played an important role in the adjustment program of 1985-89. We will examine this in more detail below. The other line in the graph shows what would have happened if the coffee surplus had remained the same as

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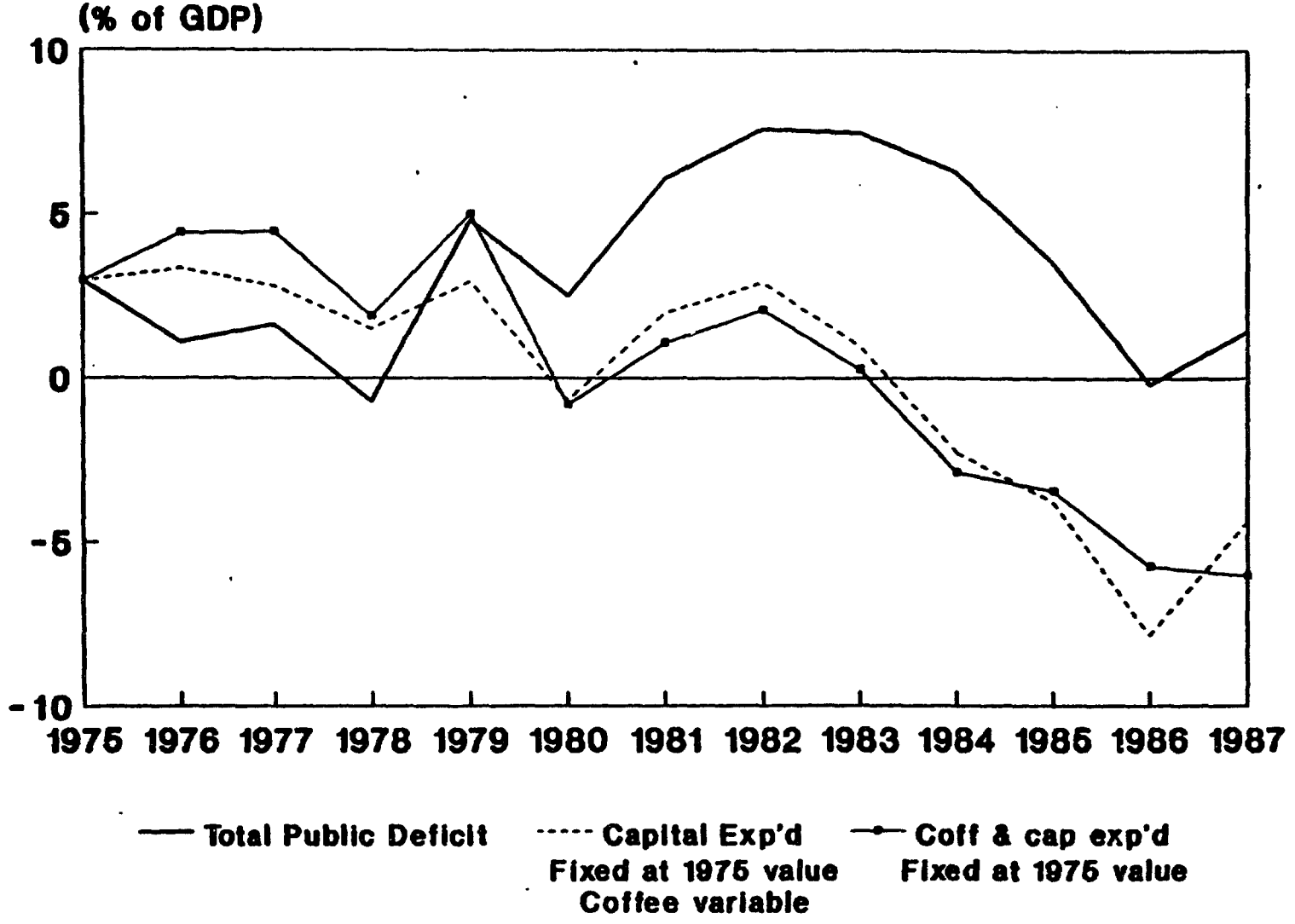
[2]The figures shown here are somewhat different from the usual numbers on the public sector in Colombia (including Table 3) because of a more comprehensive treatment of local government finances.

Figure 8

COLOMBIA: PUBLIC SECTOR DEFICIT

With & without Coffee & Capital Spending Effects



in 1975, in addition to public capital staying constant. We see that the deficit would have been significantly larger in the 1970's, implying that some fiscal problems were hidden by the good fortune of the coffee bonanza. The sharp improvement in 1986 is also shown to have depended largely on coffee.

We can get some more insight into the behavior of the public sector over time by looking at the behavior of public expenditure, shown in Figure 9. We notice first of all a tendency toward increasing size of the public sector,which was only mildly reversed during the adjustment after 1984. We see again the strong role of increasing public fixed investment in both the rise and the fall of public spending before and after 1984. The other notable development in the rapid increase in interest payments, reflecting the consequences of past domestic and foreign borrowing as well as the rise in foreign and domestic interest rates. The wage component of public spending is more stable, except after 1983 when wage compression played a role in the fall in spending.[3]

The increase in deficits in the early 1980's was financed mostly from domestic sources, although external borrowing also increased. As figure 10 shows, the expansionary fiscal policy did result in a rapid growth of the public debt ratio in the 80's, which helps to explain the incipient external debt crisis of 1983-84. But the debt accumulation was from a relatively low base compared to most other Latin American countries, so that the fiscal adjustment of 1985-89 was enough to avoid a full-blown debt crisis. The restrained use of external financing of the public sector in earlier periods helps to explain Colombia's avoidance of the kind of debt crisis that bedeviled her neighbors.

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[3]The decrease in the wage bill in 1984 is probably an accounting artifact, since there is an offsetting increase in current transfers. However, the data show wage compression in later years, as we will see in the next section.

Figure 9

COLOMBIA: Consolidated Non-Financial Public Sector Expenditure, 1975-87

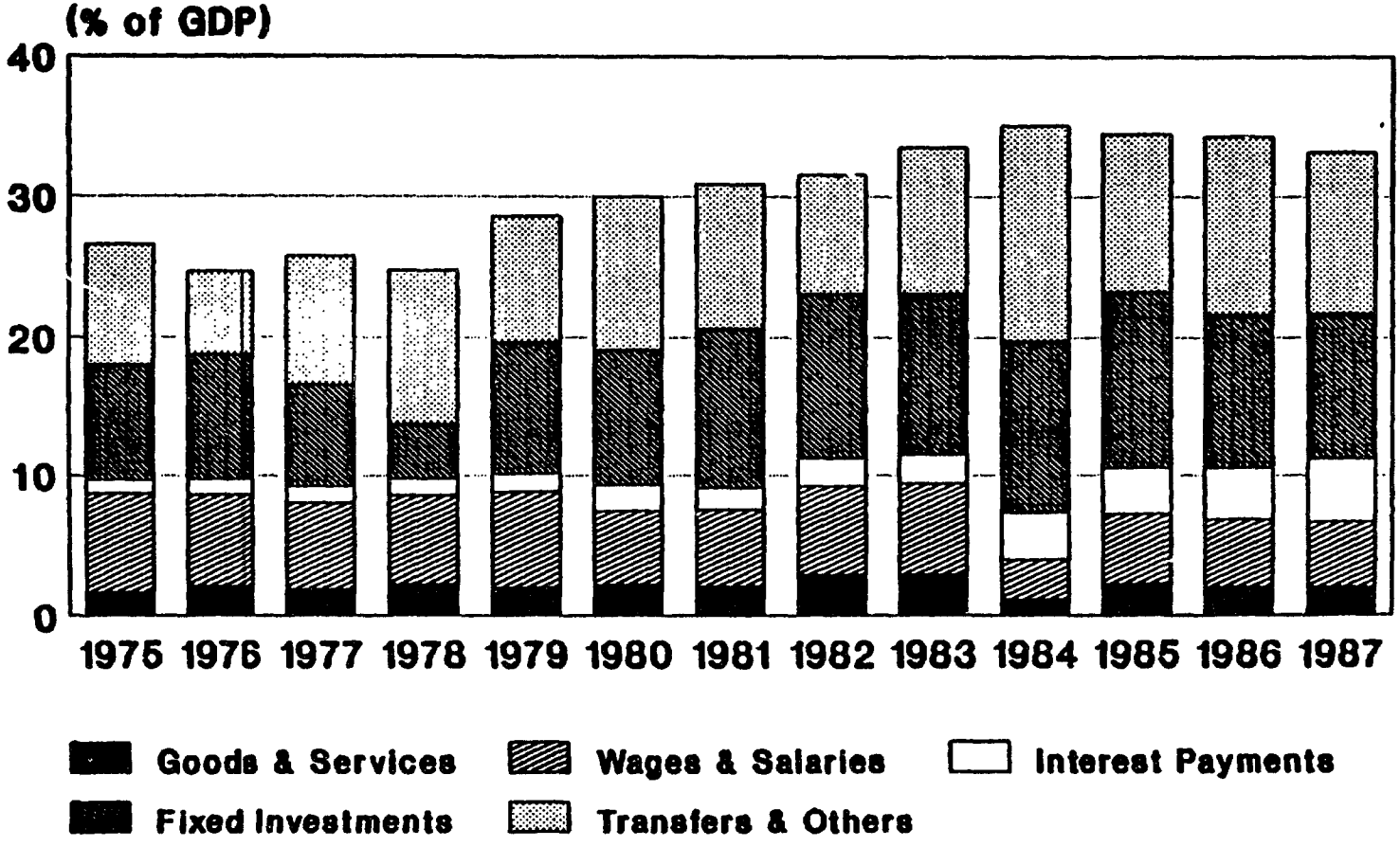
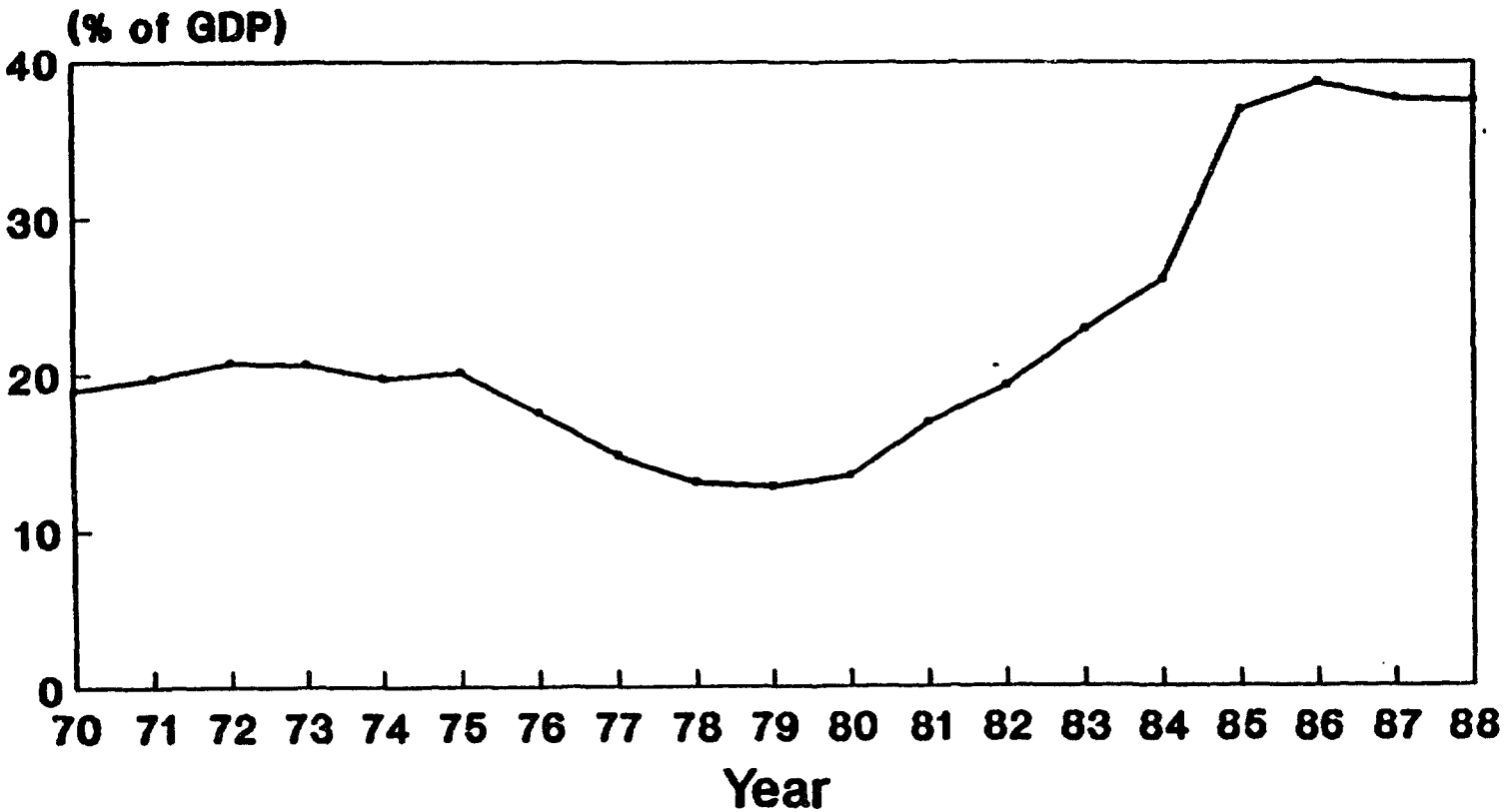


Figure 10

COLOMBIA:
Public External Debt (% GDP) 1970-88



It helped also that Colombia's fiscal expansion during 1981-84 was comparatively modest. Unlike Mexico and Argentina, the current balance of the public sector always showed a surplus, of over 2 percent of GDP. As we will see below, some of the expansion in public investment was in oil exploration and development, which paid off with a surge in oil exports after 1985.

3. The adjustment program of 1985-89

As noted earlier, the Colombian government began a major adjustment program in late 1984, which succeeded in eliminating the fiscal imbalance that had threatened to cause a macroeconomic crisis. Because of the greater availability of data and the intrinsic interest of the issues raised, it is worthwhile to examine this adjustment in somewhat more detail.

Table 3 shows the fiscal accounts for this period in more detail than the preceding table 2.[4] It is useful to distinguish two main phases of adjustment. In the initial phase the overall deficit was sharply reduced over the period from 6.3 percent of GDP in 1984 to only 0.3 percent in 1986, after which in the second phase during 1987-89 it increased again to about 2 percent of GDP. 1986 was a special year because of the surge in coffee export revenues, a good deal of which accrued to the public sector.

Domestic financing of the deficit in the first phase was sharply reduced, from nearly 5 percent of GDP in 1984 to -2.7 percent in 1986, after which it increase again to between 1 and 2 percent of GDP. It is notable that net external financing continued to be available during the first phase of the

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[4]As noted earlier, this data has somewhat different coverage than Table 2 because of a less comprehensive treatment of local government finance and different accounting conventions.

Colombia
Table 8: Non-financial Consolidated public sector, 1984-89

	1984	1985	1986	1987	1988	1989
			(As percent of GDP)			
Total revenue	19.23	21.04	23.83	22.15	22.13	22.20
Current revenue	19.00	20.73	23.64	21.85	21.87	21.88
Tax revenue	12.44	13.68	15.31	14.89	14.65	14.58
Nontax revenue	6.89	7.61	9.50	7.44	7.58	8.31
Property income	0.98	1.27	1.00	0.93	1.09	0.78
Other	2.25	2.28	1.83	2.03	1.70	2.00
Operating surplus	3.65	4.06	6.67	4.48	4.80	5.53
Current transfers	0.15	0.09	0.04	0.04	0.49	0.26
Adjustment for transfers	-0.47	-0.65	-1.21	-0.52	-0.85	-1.27
Capital revenue	0.23	0.31	0.19	0.30	0.26	0.32
Capital transfers	0.00	0.08	0.06	0.04	0.05	0.08
Other capital revenue	0.23	0.23	0.13	0.26	0.21	0.25
Total expenditure and net lending	25.51	24.58	24.15	24.14	24.22	24.44
Current expenditure	15.91	15.37	16.19	16.29	16.68	16.58
Wages and salaries	6.93	6.31	5.94	5.75	5.68	5.76
Goods and services	1.82	1.72	2.67	2 68	2.70	2.80
Interest	2.40	2.86	3.14	3.95	4.19	3.72
External debt	1.63	1.97	2.28	2.93	3.01	2.68
Domestic debt	0.77	0.89	0.86	1.02	1.18	1.04
Current transfers	4.35	3.94	3.72	3.51	3.65	3.88
Other current expenditure	0.41	0.54	0.73	0.42	0.47	0.42
Capital expenditure	9.58	9.12	7.70	7.75	7.38	7.58
Fixed capital formation	8.78	8.34	6.74	6.14	6.38	6.70
Capital transfers	0.11	0.17	0.20	0.81	0.47	0.41
Other capital expenditure	0.69	0.61	0.75	0.81	0.53	0.47
Net lending	0.01	0.09	0.26	0.11	0.16	0.27
Current account balance	3.09	5.36	7.45	5.56	5.19	5.30
Overall balance	-6.28	-3.54	-0.32	-1.99	-2.09	-2.24
Net residual	-0.48	-0.71	0.91	0.03	-0.83	0.10
Overall financing	6.76	4.25	-0.59	1.79	2.91	2.14
Foreign financing	1.90	3.78	2.08	-0.70	1.50	0.82
Disbursement	3.77	4.70	7.08	3.05	5.07	4.90
Amortization	-1.29	-1.69	-2.51	-3.25	-3.78	-4.21
Short term	-0.58	0.76	-2.48	-0.50	0.21	0.13
Domestic financing	4.86	0.47	-2.67	2.49	1.41	1.31
Banco de la Republica	3.88	0.59	-2.52	1.72	0.27	0.70
Rest of financial system	0.68	-0.09	-0.14	0.35	1.05	0.89
Suppliers credit	0.00	0.48	-0.35	0.07	0.00	0.00
Bonds	0.30	-0.50	0.30	0.30	0.10	-0.30

adjustment. Colombia did not reschedule its external debt like other Latin American borrowers. Although commercial banks were reluctant to continue lending in the wake of the global debt crisis, commercial financing was arranged with the support of 2 major World Bank adjustment loans. The large flow of external finance in 1986, which came at the same time as the surge in coffee revenues, was sucessfully sterilized through large public sector repayments of debt to the central bank and repayment of public short-term debt. In the second phase, external borrowing was consciously reduced by the authorities in favor of domestic borrowing and money creation. This may help to explain the continuing high real interest rates that was noted earlier.

We see that the adjustment in the deficit above the line took place on both sides of the balance sheet, with a reduction in spending and an increase in revenue. The cut in spending came mainly at the expense of public sector wages and fixed capital formation, in line with the typical pattern of Latin American adjustment. The increase in revenue came primarily from increased tax revenue and an increased operating surplus of public enterprises; mainly the National Coffee Fund and the state oil company, ECOPETROL. The increase in taxes came about through a surcharge on imports of 8 percent (of import value) that was implemented in 1985.

Because of the importance of the fortuitous coffee boom of 1986 in the adjustment, the question naturally arises to what extent the fiscal improvement was a temporary one. Table 4 addresses this issue by decomposing the deficit into its temporary and structural components. The first part of the table separates out various fiscal components that are intrinsically temporary or are highly volatile. These include the overall balance of the National Coffee Fund as well as the transfers it made to the rest of the public sector. Also included

Colombia

TABLE 4: STRUCTURAL TRENDS IN FISCAL POLICY DURING ADJUSTMENT, 1984-89

Percent of GDP (+ deficit/-surplus)	1984	1985	1986	1987	1988	1989	Change 1984-89
Total consolidated public sector deficit	6.8	3.5	0.8	2.0	2.1	2.2	-4.04
National Coffee Fund--Deficit	-0.4	-1.4	-3.2	0.6	-0.0	-0.1	0.27
--Transfers to Public Sector	0.0	0.0	0.1	0.3	0.0	0.0	0.00
ECOPETROL--Deficit	-0.1	1.2	0.2	-0.8	0.0	-0.4	-0.26
--Transfers to Public Sector	0.1	0.1	0.2	0.6	0.6	0.7	0.64
National government--temporary items\1	0.1	0.1	0.3	0.5	0.1	0.1	-0.01
Effect of real devaluation\2	0.0	0.1	0.4	0.4	0.3	0.4	0.38
Structural deficit	7.0	4.0	4.2	4.0	3.2	4.0	-3.05
Fixed capital formation	8.8	8.3	8.7	8.1	8.4	8.7	-2.08
Structural current deficit	-1.8	-4.3	-2.5	-2.2	-3.2	-2.7	-0.97
Wages & Salaries	6.9	6.3	5.9	5.7	5.7	5.6	-1.17
Structural current deficit net of wages	-8.7	-10.6	-8.5	-7.9	-8.9	-8.5	0.19
Import surcharge	0.1	0.6	0.7	1.0	1.1	1 0	0.96
Structural current deficit net of wages and import surcharge	-8.6	-10.1	-7.8	-6.9	-7.8	-7.5	1.16
Interest payments	2.4	2.9	3.1	4.0	4.2	3.7	1.32
Structural current primary deficit (net of wages & import taxes)	-11.0	-12.9	-10.9	-10.9	-12.0	-11.2	-0.16
Memo: Total real exchange rate devaluation effect	0.0	0.1	1.3	0.7	0.6	0.9	0.91
Total deficit excluding devaluation effect	6.8	3.7	1.6	2.7	2.7	3.2	-3.13

\1 Includes coffee tax (2.5% of coffee exports), ECOPETROL backpayment of duties, Decreto 350-1988, and special revenue from the tax amnesty (in 1987).

\2 Includes the effect of the real devaluation since 1984 on those items not included elsewhere in this table.

is the balance and transfers of ECOPETROL, which became a large source of financing to the rest of the public sector by 1987 thanks to the development of a major new oil field. The fiscal improvement was helped in the first phase of the adjustment by increased profits of the National Coffee Fund, which was the primary beneficiary of the surge in international coffee prices in 1986, and in the second phase of the adjustment by ECOPETROL. There were also some intrinsically temporary developments that influenced the national government's balance, the main one being a tax amnesty that increased revenues in 1987. Finally, there is the effect of the real devaluation that took place beginning in 1985. This had a favorable effect on the fiscal balance, which was temporary in the sense that it corrected an unsustainable overvaluation of the exchange rate.

Taking all of these factors into account, we find that there was still a substantial improvement in the "structural deficit". Only one percentage point of GDP of improvement in the deficit over 1984-89 is explained by the temporary factors, so that a fiscal improvement of 3 percentage points of GDP still remains. Colombia benefitted from good luck, but the main part of the adjustment was due to her own efforts.

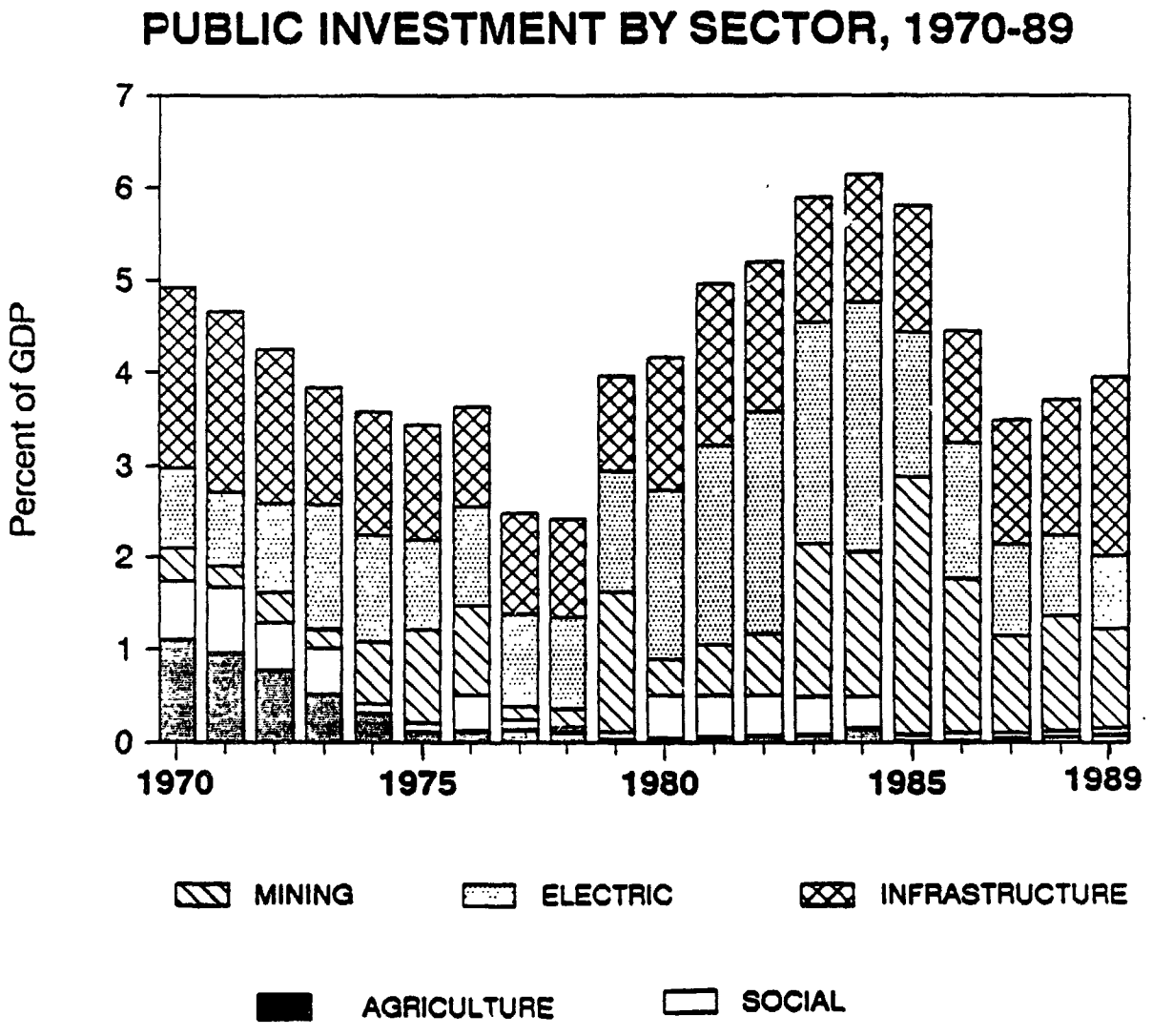
Another related question that arises is how much the fiscal improvement was achieved through lasting policy changes as opposed to temporary expedients. The evaluation of the adjustment according to this criterion is not so favorable. In the second part of table 4, the change in the "structural" deficit is explained by only four specific fiscal components: public investment, wages, a surcharge on imports, and interest payments. The reduction in public investment accounts for two percentage points of the reduction in the structural deficit. We will examine the composition of this change below. The cut in

spending on public wages, which accounts for one percent of the improvement in the fiscal deficit, largely reflects expedience since it was achieved through a decline in real wage rates ratner than a rational retrenchment of public employment. These two items alone fully explain the improvement in the structural deficit over the adjustment period.

The last two items in the table are roughly offsetting. The increase in interest payments reflects the consequences of the previous build-up of debt, the shift toward paying market interest rates on domestic debt, and the effect of the real devaluation on external interest payments. The major source of increased revenue to keep up with the increased interest burden was the increase in the tax on imports mentioned earlier. While increased revenue was desirable, the means chosen again was driven mainly by expedience than rational long-run policy. Higher growth in the future likely requires increased openness, which will eventually require a reduction of tariff rates.

In order to evaluate the reduction in public investment, we need more information about the composition of the cuts. Figure 11 shows the evolution of public investment since 1970. As was noted earlier, much of the fiscal expansion that triggered the near-crisis was due tc public investments in electric power and in mining (coal and oil). There was also some expansion in social sector investments. The sectors that expanded earlier were precisely those cut during the adjustment program. The largest adjustment came in the electric power sector. This was a rational reduction in spending, since excess generation capacity had been created during the large investments of the early 80's. The large reduction of investment in the mining sector mostly reflected the phasing out of lumpy expenditures on the development of the new oil and coal fields. Moreover, expenditure on infrastructure actually expanded during the adjustment

Figure 11


PUBLIC INVESTMENT BY SECTOR, 1970-89
Percent of GDP
0
1
2
3
4
5
6
7
1970
1975
1980
1985
1989
MINING
ELECTRIC
INFRASTRUCTURE
AGRICULTURE
SOCIAL

program, which largely reflected spending on the telecommunications sector and the construction of a metro in Medellin (although the latter was of dubious economic value). More questionable for long-run prospects was the large reduction in social investments during the adjustment program and the failure to increase agriculture investment. On balance, the largest part of the public investment reduction was rational and not necessarily prejudicial to future growth.

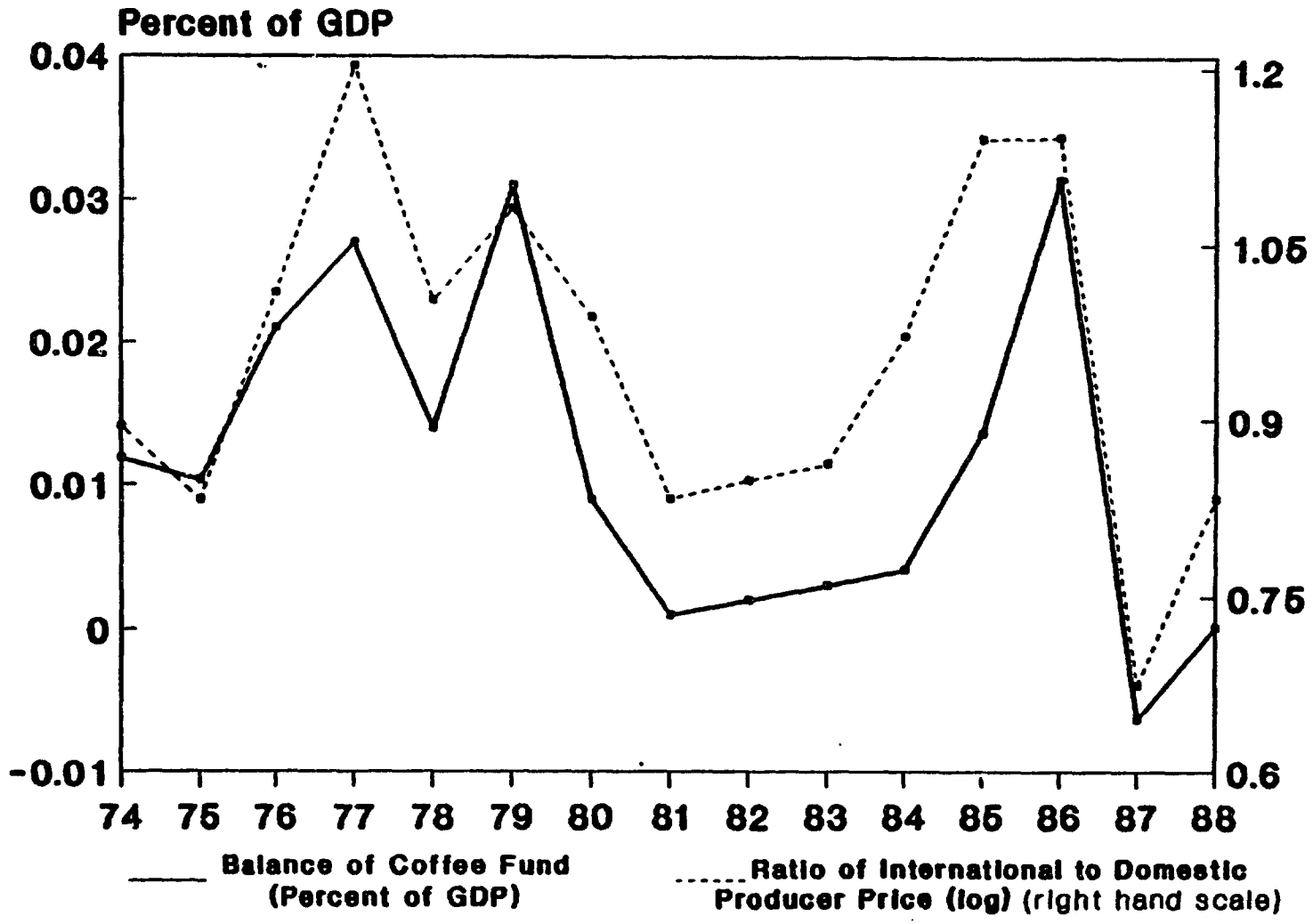
The conclusions of table 4 are rather mixed. They suggest that some means chosen for fiscal adjustment were prejudical to long-run growth. Improved growth performance will likely require the reversal of some of the fiscal adjustment measures of 1985-89 and their replacement by less distortionary fiscal instruments to maintain the deficit within bounds.

4. Decomposition of the coffee balance in Colombia

The balance of the National Coffee Fund in Colombia is one of the most important, and most volatile, components of the overall public sector deficit. As shown in figure 12, it has swung widely over the past decade. The sharp improvement in public sector finances in 1986, for example, was in good part due to an improvement in the balance of the Coffee Fund. The Coffee Fund's financial balance is the main transmission mechanism for the wide swings in world coffee prices to affect the fiscal balance. It is also an important way in which the real exchange rate affects the fiscal balance. It is useful to first describe how the coffee price and the real exchange rate will affect the Coffee Fund, and then do a numerical decomposition of the coffee balance into autonomous and endogenous components.

Figure 12

COLOMBIA: BALANCE OF COFFEE FUND AND PRODUCER PRICE RATIO



The National Coffee Fund is a quasi-public institution that administers a bewildering array of coffee policy instruments in consultation with the national government. Through various instruments it creates a wedge between the international price of coffee and the domestic producer price that it pays to private coffee farmers. The majority of the Colombian coffee crop passes through the Fund before being exported, and so it receives revenues from the price differential. The domestic producer price is adjusted in response to changes in the exchange rate and the dollar coffee price, but the pass-though is not 100 percent; we will estimate a reaction function below. In effect, the Coffee Fund plays a traditional price-smoothing role for domestic producers. This implies that the ratio of world to domestic producer prices will go up (and Coffee Fund net revenues will go up) when either the real exchange rate depreciates or the coffee price increases.

In addition, there is a tax on coffee export revenues that is shared between the national government and the coffee fund. This tax implies that there will be a direct effect of both the real exchange rate and the international coffee price on Coffee Fund net revenues besides the effect through the producer price ratio.

Figure 12 shows the behavior of the coffee balance and the producer price ratio, which in turn depends on world coffee prices and the real exchange rate. The balance of the Coffee Fund follows closely the coffee price cycle. Large surpluses were associated with peaks in coffee prices in 1977 and 1986. The producer price ratio also mirrors closely the behavior of international prices, as is consistent with price-smoothing behavior.

The association with the real exchange rate is more complicated. The real exchange rate peaked before coffee prices in 1975, then appreciated as

coffee prices rose. The two phenomena are linked, since the coffee price has a strong effect on the overall terms of trade, which as we will see elsewhere in the paper, negatively affects the real exchange rate in the long run. In 1986, the effect of the rise in the coffee price on Coffee Fund finances was reinforced by a strong real depreciation in 1985-86.

These associations are confirmed by econometric results. Regression 1 shows the ratio of the Coffee Fund surplus to GDP as a function of the producer price ratio and the real domestic unit value of coffee exports. The latter is the product of the real international price of coffee and the real exchange rate. Both variables are statistically significant with the expected signs.
The results indicate that a higher producer price ratio leads to a higher Coffee Fund surplus; this is to be expected since the excess of international prices over domestic producer prices is the Coffee Fund's profit margin on purchases of coffee for export. In addition, there is a significant positive effect of the real domestic unit value of coffee exports; this reflects the direct tax on coffee exports that partially accrues to the Coffee Fund.

We also find a strong econometric relationship between the producer price ratio and the real exchange rate and world coffee price. Here we try different specifications for a reaction function for the authorities to adjust the domestic producer price in response to changes in the exchange rate and world coffee price.

The first specification is an error correction model for the nominal domestic producer price to adjust to the nominal exchange rate and the world coffee price in nominal dollars. The error correction approach is useful to detect spurious correlations between variables, as well as giving an appealing

Regression 1

Variables:

LG1COFFD&GDP	= log(1+ Coffee fund surplus/GDP)
LN(COFF_INT&DOM)	= log(Int'l/Domestic Coffee price)
LNCOFF_WRL3	= log(Int'l Coffee price) + log(Avg Exch Rate) - log(CPI)

REGRESS : dependent variable is LG1COFFD&GDP

Using 1974 - 1988

Variable	Coefficient	Std Err	T-stat	Signf
Constant	-.439365E-01	.10572E-01	-4.17440	.001
LN(COFF_INT&DOM)	.456545E-01	.143980E-01	3.17090	.008
LNCOFF_WRL3	.137274E-01	.662450E-02	2.07222	.060

Equation Summary

No. of Observations =	15	R2= .8035	(adj)= .7707
Sum of Sq. Resid.	= .362563E-03	Std. Error of Reg.	= .5497E-02
Log(likelihood)	= 58.4436	Durbin-Watson	= 2.08685
Schwarz Criterion	= 54.3816	F (2, 12)	= 24.5295
Akaike Criterion	= 55.4436	Significance	= .000058

model of short-run adjustment and long-run equilibrium. We use the 2-stage procedure suggested by Engle and Granger (1987).

Regressions 2 and 3 show the first and second stage regressions. In the first stage regression, the level of the log of the domestic producer price is regressed on the the levels of the log exchange rate and log international coffee price. This regression can be interpreted as the long run relationship between these variables. Note that the coefficient on the exchange rate is close to one, while that on the coffee price implies only 71 percent pass-through.

Regression 2

Variables:

LNCOFDOMP = log(Domestic coffee price)
LNCOFXPINTL = log(International coffee price)
LNEXCH_AVG = log(Average Exchange Rate)

REGRESS : dependent variable is LNCOFDOMP

Using 1970 - 1988

Variable	Coefficient	Std Err	T-stat	Signf
CONSTANT	-.339408	.120838	-2.80878	.013
LNCOFXPINTL	.710606	.558219E-01	12.7299	.000
LNEXCH_AVG	1.06649	.312462E-01	34.1316	.000

---------- Equation Summary ----------

No. of Observations =	19	R2= .9939	(adj)= .9932
Sum of Sq. Resid. =	.143654	Std. Error of Reg.=	.9475E-01
Log(likelihood) =	19.4456	Durbin-Watson =	1.38480
Schwarz Criterion =	15.0290	F (2, 16) =	1313.72
Akaike Criterion =	16.4456	Significance =	.000000

In the second stage regression, shown as Regression 3, the log difference of the domestic producer price is determined by the log differences of the exchange

Regression 3

Variables:

DLNCOFD = log(Domest Coff price)$_t$ - log(Domest Coff price)$_{t-1}$
DLNCOFXPINTL = log(Int'l Coff price)$_t$ - log(Int'l Coff price)$_{t-1}$
DLNEXCH_AVG = log(Avg Exch rate)$_t$ - log(Avg Exch rate)$_{t-1}$

REGRESS : dependent variable is DLNCOFD

Using 1971 - 1988

Variable	Coefficient	Std Err	T-stat	Signf
CONSTANT	.621103E-01	.365742E-01	1.69820	.112
DLNCOFXPINTL	.521414	.641270E-01	8.13095	.000
DLNEXCH_AVG	.730801	.207096	3.52880	.003
RESID(-1)	-.710178	.193716	-3.66608	.003

---------- Equation Summary ----------

No. of Observations =	18	R2= .8658 (adj)=	.8370
Sum of Sq. Resid. =	.731925E-01	Std. Error of Reg.=	.7231E-01
Log(likelihood) =	24.0044	Durbin-Watson =	1.57765
Schwarz Criterion =	18.2237	F (3, 14) =	30.0974
Akaike Criterion =	20.0044	Significance =	.000002

rate and coffee price, plus the lagged residual from the first stage regression. The latter can be interpreted as the "correction" for the deviation of the domestic price from its long-run relationship. The coefficient on the coffee price is even lower than in the first regression, implying only 52 percent pass-through, while the coefficient on the exchange rate implies 73 percent pass-through. The coefficient on the "correction" term implies that 71 percent of a deviation from the long-run relationship is corrected in the first period. All of the variables are highly significant.

We try an alternative specification of the real domestic producer price as determined by the real world coffee price and the real exchange rate. This implicitly assumes that domestic producer prices are indexed fully to domestic inflation, then adjusted for changes in external fundamentals such as coffee prices and the exchange rate. The first-stage regression in levels is shown as Regression 4, and the second-stage regression is shown as Regression 5. The first-stage regression shows somewhat lower pass-through of coffee prices and exchange rates than in the previous specification. The real coffee price is strongly significant in the second stage, with pass-through again close to

Regression 4

Variables:

LNCOFDM_CPI = log(Domestic coffee price) - log(CPI)
LNCOFINTL_WPI = log(US$ Int'l coffee price) - log(USA Wholesale Price Index)
LNEXCH_CPI_WPI = log(Avg Exch rate) - log(CPI) + log(USA WPI)

REGRESS : dependent variable is LNCOFDM_CPI

Using 1970 - 1988

Variable	Coefficient	Std Err	T-stat	Signf
CONSTANT	-1.07446	.815152	-1.31811	.206
LNCOFINTL_WPI	.605558	.770591E-01	7.85836	.000
LNEXCH_CPI_WPI	.865795	.172869	5.00838	.000

Equation Summary

No. of Observations =	19	R2= .8162 (adj)=	.7932
Sum of Sq. Resid. =	.147591	Std. Error of Reg.=	.96044E-01
Log(likelihood) =	19.1888	Durbin-Watson =	1.10250
Schwarz Criterion =	14.7721	F (2, 16) =	35.5207
Akaike Criterion =	16.1888	Significance =	.000001

about 50 percent. The error correction term is again strongly significant, and even higher than before, implying around 85 percent correction of deviation from equilibrium in the first period. However, the exchange rate term is not significantly different than zero in the second-stage regression. There is no evidence here to support an effect of the real exchange rate on the real producer price.

The two specifications give fairly similar results for simulation of coffee surpluses and producer price ratios. The second specification is chosen

Regression 5

Variables:

DLNCOFDM_CPI = $lncofdm\_cpi_t - lncofdm\_cpi_{t-1}$
DLNCOFINTL_WPI = $lncofintl\_wpi_t - lncofintl\_wpi_{t-1}$
DLNEXCH_CPI_WPI = $lnexch\_cpi\_wpi_t - lnexch\_cpi\_wpi_{t-1}$

REGRESS : dependent variable is DLNCOFDM_CPI

Using 1971 - 1988

Variable	Coefficient	Std Err	T-stat	Signf
CONSTANT	.469365E-02	.194324E-01	.241537	.813
DLNCOFINTL_WPI	.513535	.682378E-01	7.52567	.000
DLNEXCH_CPI_WPI	.234655	.361924	.648354	.527
RESID1(-1)	-.849083	.257471	-3.29778	.005

Equation Summary

No. of Observations =	18	R2= .8467 (adj)=	.8138
Sum of Sq. Resid. =	.863603E-01	Std. Error of Reg.=	.7854E-01
Log(likelihood) =	22.5155	Durbin-Watson =	1.74491
Schwarz Criterion =	16.7347	F (3, 14) =	25.7731
Akaike Criterion =	18.5155	Significance =	.000006

for decomposition of the deficit because the resulting decompositions are more intuitively plausible. Figures 13 and 14 show the model simulation for the coffee surplus and the producer price ratio. We see that the model tracks well the main swings of the cycle. The main departure from the model is the rise in both the coffee surplus and producer price ratio in 1979, which is not explained by movements of the real exchange rate or coffee price.

We can use the model to decompose the deficit into elements determined by coffee price changes, real exchange rate changes, and other. To do this, we simulate the model first for the actual values of the real coffee price and the

Figure 13

COLOMBIA: BALANCE OF COFFEE FUND
ACTUAL AND SIMULATED VALUES

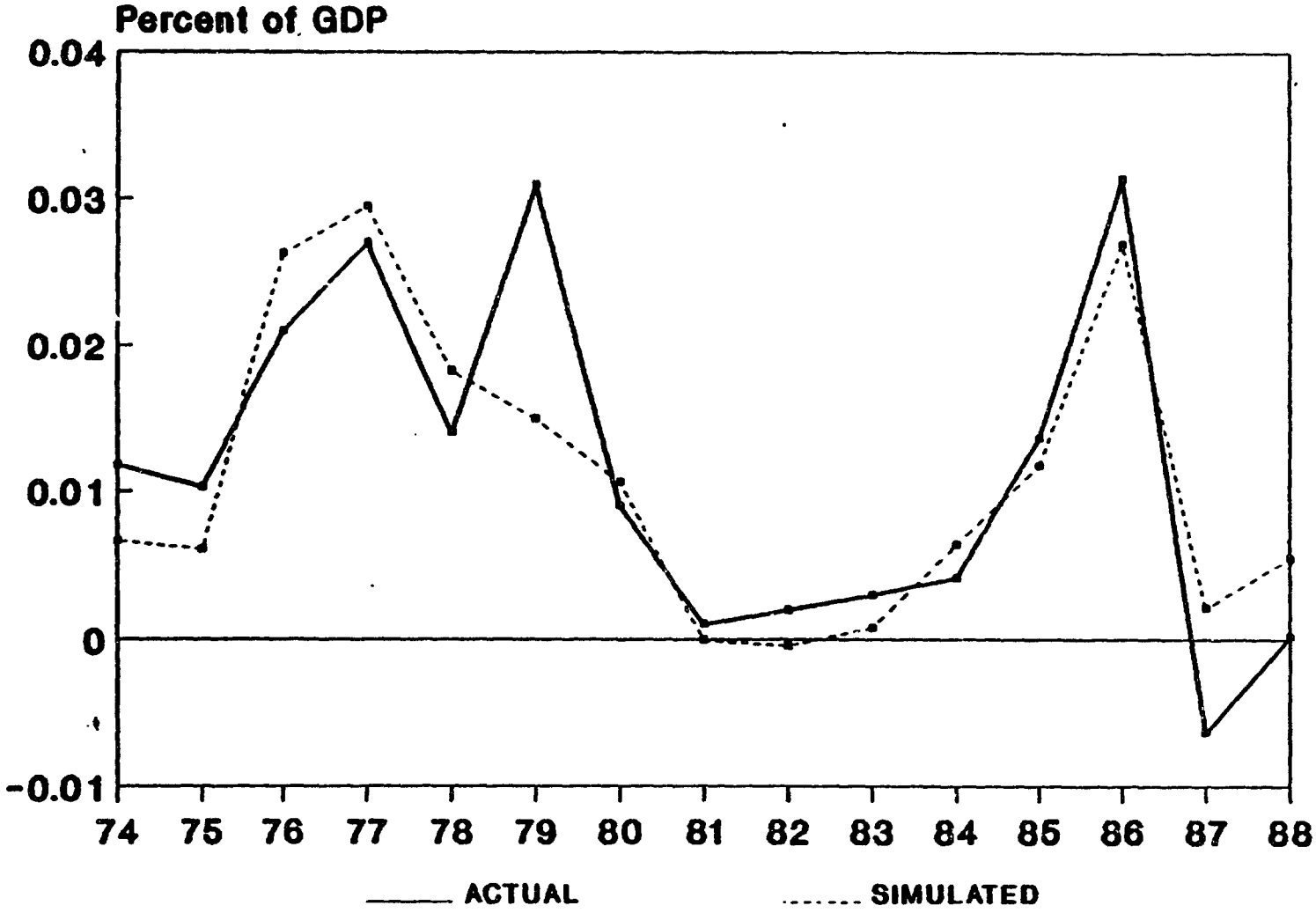
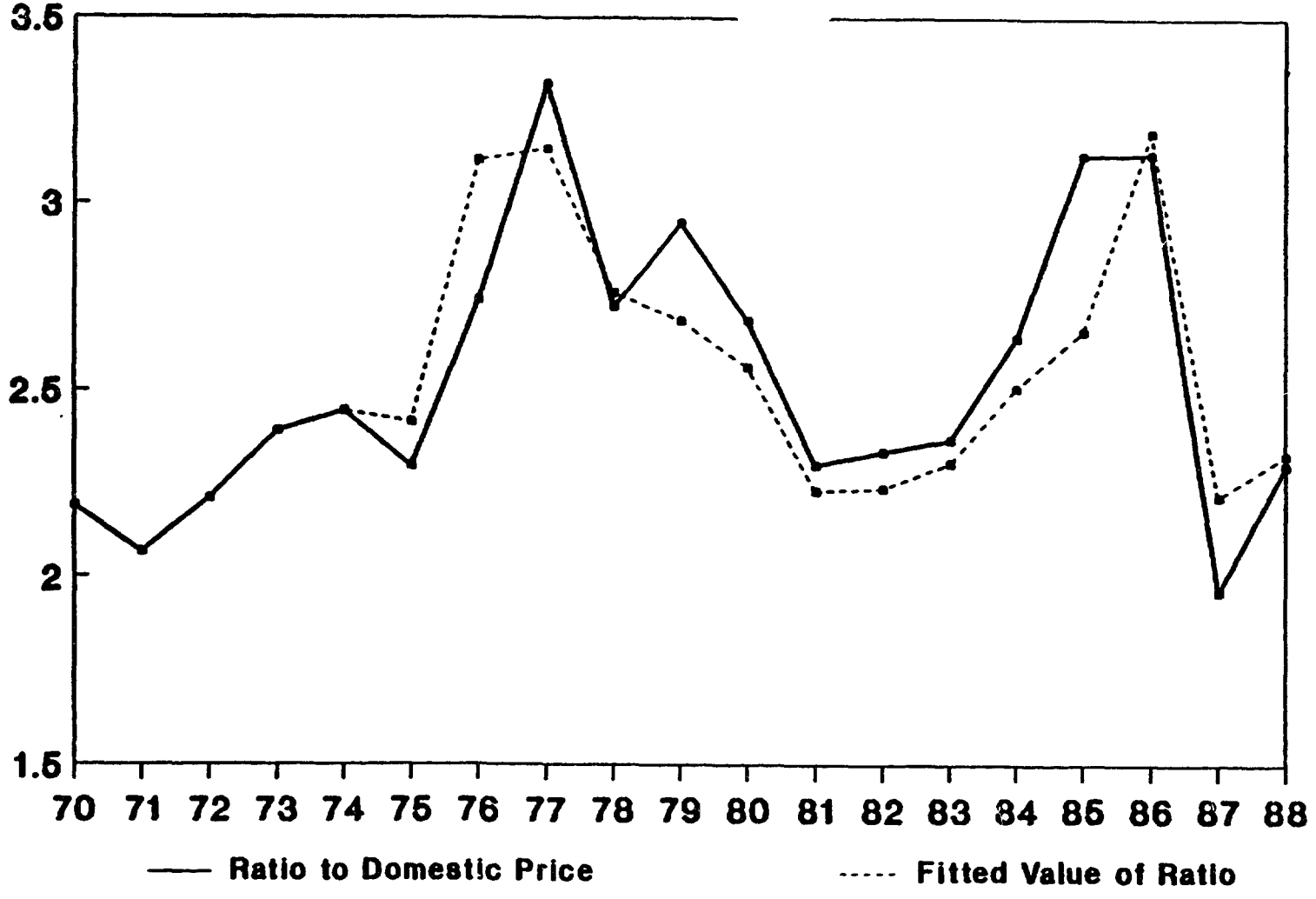


Figure 14

COLOMBIA: Ratio of International to Domestic Producer Coffee Price



real exchange rate. We then simulate the model for the coffee price and the real exchange rate fixed at their 1974 values. The difference between these two simulations is the amount of the surplus that is accounted for by the change since 1974 in the real exchange rate and the coffee price. To distinguish between them, we fix one of the variables at the 1974 value and let the other take its actual value. The difference between this simulation and the one in which both are fixed is the amount of the surplus explained by the variable that we allow to take its actual value.

Figure 15 shows the resulting decomposition of the coffee surplus. It is clear that the coffee price is the dominant influence on the behavior of the coffee surplus, accounting especially for the peaks in 1977 and 1986. The coffee price effect amounted to 3 percent of GDP in 1977 and 1 percent of GDP in 1986, reverting to -1 percent with the collapse of prices in 1987.

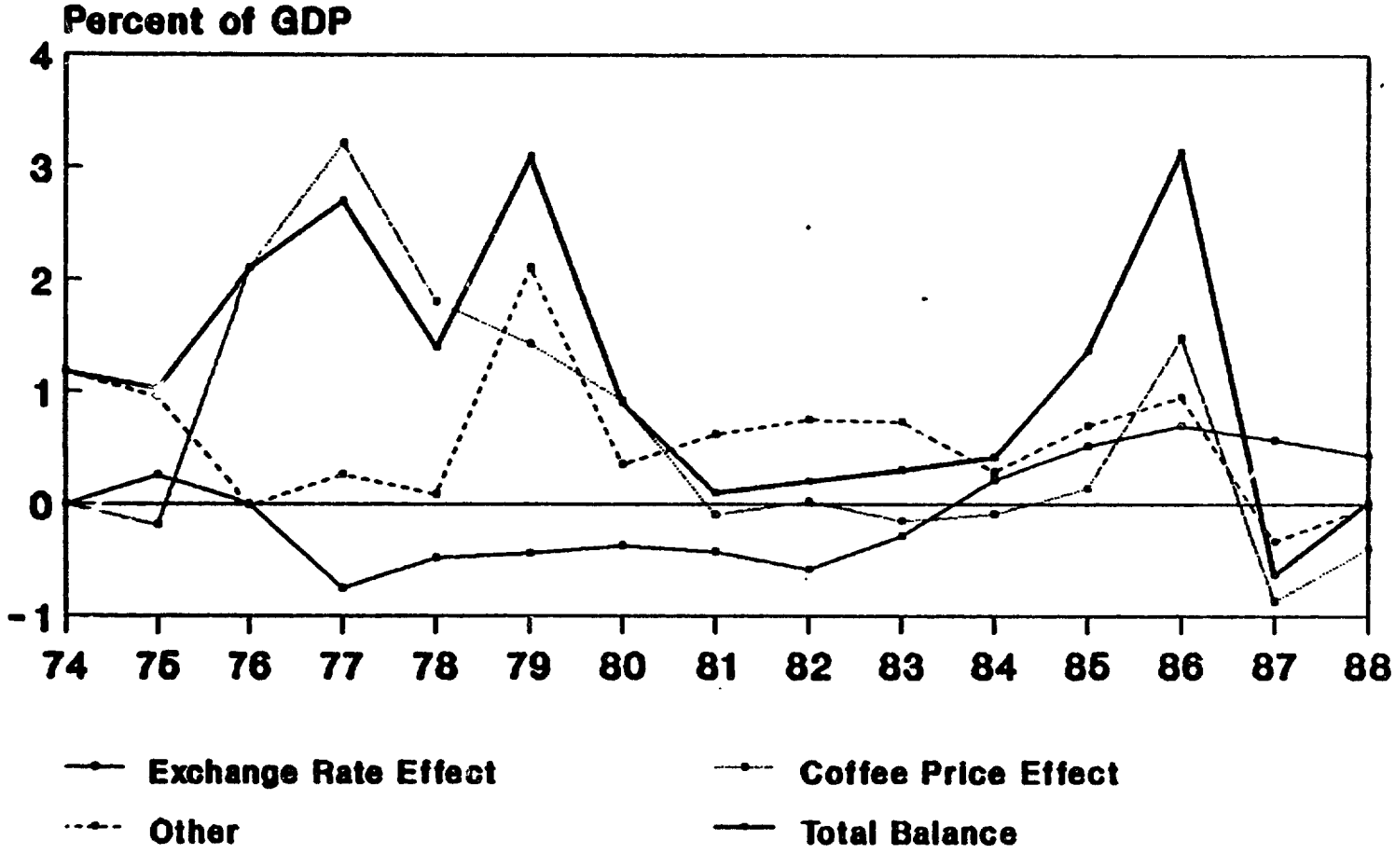
The real exchange rate plays a comparatively minor role, depressing the coffee surplus in the late 70's and early 80's, and increasing it in 1985-87. The residual surplus (labelled "other" in the graph) is the sum of the underlying surplus given by the simulation in which both the coffee price and real exchange rate are fixed (about half a percent of GDP and roughly constant) and the residual from the simulation with both independent variables taking their actual values. The residual surplus plays some role in the fluctuations of the coffee surplus, especially in 1979 and 1987. This reflects both the unexplained portion of the producer price ratio (which was significant in 1979), and autonomous actions by the Coffee Fund such as purchases or sales of inventories.

In conclusion, the coffee surplus plays a major role in the public finances of Colombia, being the major vehicle by which exogenous terms of trade

Figure 15

COFFEE BALANCE DECOMPOSITION

Exchange Rate and Coffee Price Effects



shocks to coffee prices affect public sector deficits. We have seen that the real coffee price affects the coffee surplus through both the producer price ratio and directly through coffee export tax revenues; the total effect has ranged from plus 3 percent to -1 percent of GDP over the period 1975-88. The real exchange rate plays a comparatively minor role. Autonomous movements in the coffee surplus have also been important in some years.

III. FISCAL DEFICITS, REAL INTEREST RATES, AND INFLATION

1. Basic framework

To analyze the effect of the financing of fiscal deficits on interest rates and inflation, we use the model presented in the proposal. For convenience, the basic structure will be presented here. The basic relationship is that of the fiscal deficit (Def) to its means of financing:

$$(1) \qquad Def = \dot{L}_{dg} + \dot{L}_{dg} + \dot{F}^{*}_{g} \cdot E + \dot{BNOL}_{g}$$

where L_{dg} is government borrowing from the banking system, L_{cg} is credit from the central bank, F_g is foreign debt, and $BNOL_g$ are net other liabilities of the government. The evolution of government borrowing from the banking system and the central bank determine the equilibria in the market for credit and the money market, respectively. These two markets are cleared by the domestic interest rate and the price level. Thus, it is the composition of financing of the deficit that will determine the interest rate and inflation rate in this model.[5]

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[5]This is similar to the consistency relationship between fiscal deficits and inflation proposed by Anand and Van Wijnbergen (1989), except that we also allow for portfolio shifts between money and interest-bearing assets.

The equilibrium in the credit market will be given by:

$$(2) \qquad L_{dg} = (1-r)\, P_c (M1\ (1-c) + QM) - L_{dp} - Othd$$

where r is the reserve requirement, P_c is the consumption deflator, M1 is real demand for narrow money, c is the ratio of currency to narrow money, QM is real demand for quasimoney, L_{dp} is private demand for credit, and Othd is net other assets of the banking system. This expression just says that deposits in the banking system, less the amount set aside for reserves, must be equal to private and public credit demand plus net other assets of the banking system.

Private credit demand L_{dp} will evolve with private investment Ip:

$$(3) \qquad L_{dp} = (1+\pi)(1-\zeta_R)\, L_{dp}(-1) + P \cdot I_p \cdot \gamma$$

where π is the inflation rate (in terms of the GDP deflator), ζ_R is the rate of depreciation of physical capital, P is the GDP deflator, I_p is private investment, and γ is the ratio of private credit to the private capital stock. This expression is derived from the assumption that the ratio of private domestic debt to the nominal value of capital (the leverage ratio) stays constant over time. This implies that the inflation component of interest payments on the debt (π times the previous stock of debt) will always be rolled over. A constant share of gross investment will be financed by borrowing, but there will be an adjustment for depreciation on past capital, as reflected in past debt.

The equilibrium in the money market will be given by the condition that the supply of high-powered money H equal the demand:

$$(4) \qquad H = P \cdot M1 \cdot (c+r\,(1-c)) + r \cdot P \cdot QM$$

where the components correspond to currency demand, reserves on demand deposits, and reserves on quasimoney, respectively. The supply of high-powered money must be in turn consistent with the outstanding credit to the government by the central bank:

$$(5) \qquad L_{cg} = H - NFA_{cb} - Othc$$

where NFAcb are net foreign assets of the central bank, and Othc are net other assets of the central bank.

2. Econometrically-estimated behavioral equations

To complete this framework, we need to specify behavioral equations for money demand, quasimoney demand, private investment, and total output, as well as determining interest rate spreads. We also must estimate an equation for private consumption so as to determine the private saving flow that corresponds to accumulation of money and quasimoney.

For private portfolio demands, we suppose a 3 asset system of money, quasimoney, and foreign assets. It is enough to specify behavioral equations for the first two, with foreign assets determined as a residual from the balance sheet condition for the private sector. Although holding of foreign assets is legally restricted in Colombia, the existence of a thriving underground economy and a flow of remittances from abroad make for a high degree of defacto capital mobility. The existence of a parallel market premium implies mobility is not

perfect, but the premium is seldom above 5 percent (and sometimes is even negative!)

We thus model quasimoney demand as reflecting the possibility of substitution between domestic and foreign interest-bearing assets. Real quasimoney demand (deflated by the consumption deflator) is hypothesized to be a function of domestic interest rates, the inflation rate (reflecting also the possibility of substitution into real assets), the foreign interest rate plus the rate of depreciation, and real income. In the estimation process, we were not able to identify any separate effect of currency depreciation in addition to the effect of inflation. This probably reflects the crawling peg system in Colombia, in which current inflation is the best predictor of future depreciation (the occasional large devaluations are usually unanticipated). We also constrain the income elasticity of demand for quasimoney to be one in the estimation.[6] Thus, the estimated equation shows the log of the ratio of real quasimoney to GDP as a function of the real deposit rate, which is the nominal deposit rate adjusted for the ex-post rise in the consumption deflator. The results are shown as Regression (6):

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[6]This restriction is emphatically rejected by the data, which would imply an income elasticity of 2.4. Such a large elasticity would lead to implausible simulation results, so we impose the income elasticity of unity. The reasons for the explosive income elasticity will be investigated in further research. For an analysis of stability of money demand, see Carrasquilla and Renteria (1990).

Regression (6)

CORC : dependent variable is Demand for Log (quasi-money/GDP)

Using 1973 - 1988

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	-2.47391	0.186360	-13.2749	0.000
Real interest rate	1.43222	0.625282	2.29051	0.038
Lagged error term[7]	0.849253	0.131997	6.43390	0.000

---------- Equation Summary ----------

No. of Observations =	16	R2= 0.9200	(adj)= 0.9142
Sum of Sq. Resid =	0.169050	Std. Error of Reg.=	0.109886
Log(likelihood) =	13.6982	Durbin-Watson =	1.89415
Schwarz Criterion =	10.9256	F (1, 14) =	160.900
Akaike Criterion =	11.6982	Significance =	0.000000

---------- Autocorrelation Estimation Summary ----------

Initial Rho(1) =	0.00000	Final Rho(1) =	0.84925
Std Error of Rho(1) =	0.13200	t-value (sig) =	6.434 (0.000)

R-Squared based on transformed (differenced) model = 0.42596

Convergence at iteration 7

The real demand for narrow money is specified to depend on the nominal deposit interest rate and real income. The results for a regression in levels were unsatisfactory, so we specified an error correction format. Regression (7a) shows the first stage levels regression of the log of real money on the log of real gdp, the nominal interest rate, and a time trend. Regression (7b) gives the regression in differences with the lagged residual from the first stage regression as one of the explanatory variables. Both real income and the nominal interest rate are significant, as is the residual from the first stage regression. This specification has the intuitively appealing interpretation that the real growth in money demand responds to real income growth and changes in

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[7] or the ^RHO which is the autocorrelation coefficient from the Cochrane-Orcutt regression.

interest rates, with a correction for the long run relationship between levels of money and GDP. The negative time trend in the levels regression implies a secular tendency to move away from M1, which could reflect technical change that economizes on the use of money in transactions.

Regression (7a)

REGRESS : dependent variable is Ln (Real M1)

Using 1965 - 1988

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	-12.9757	3.47126	-3.73804	0.001
Ln (Real GDP)	1.73268	0.228106	7.59594	0.000
Nominal Interest rate	-0.218988	0.178090	-1.22965	0.233
Time Trend	-0.409874E-01	0.101437E-01	-4.04069	0.001

Equation Summary

No. of Observations =	24	R2= 0.9727 (adj)=	0.9686
Sum of Sq. Resid. =	0.431522E-01	Std. Error of Reg.=	0.464501E-01
Log(likelihood) =	41.7984	Durbin-Watson =	1.18149
Schwarz Criterion =	35.4423	F (3, 20) =	237.672
Akaike Criterion =	37.7984	Significance =	0.000000

In the estimation of the behavioral equation for private investment, only real income and the user cost of capital were found to be significant. We tested the hypothesis in the project proposal that the public capital stock has a positive effect on private investment, but this was not confirmed by the data. Capacity utilization and profit variables were also tried without success. The final estimation -- shown as regression (8) -- constrains the income elasticity of private investment demand to be one, which was not rejected by the data. The user cost of capital is defined as the relative price of capital goods (the investment deflator divided by the GDP deflator) times the real interest rate

(the nominal loan rate adjusted for the change in the GDP deflator). The change in the GDP deflator worked better than the ex-post rate of change in the investment deflator as a measure of the expected capital price increase in the real interest rate definition, perhaps reflecting again the smoothness of inflation over time except for unexpected shifts in relative prices of investment goods.

Regression (7b)

REGRESS : dependent variable is Money Demand = log(real m1) - log(real m1(-1))

Using 1966 - 1988

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	-0.342711E-01	0.272399E-01	-1.25812	0.224
Difference ln(gdp)	1.66381	0.561546	2.96290	0.008
Difference int rate	-0.532078	0.238691	-2.22915	0.038
Lagged residual	-0.692107	0.259542	-2.66665	0.015

Equation Summary

No. of Observations =	23	R2= 0.4369	(adj)= 0.3480
Sum of Sq. Resid. =	0.339841E-01	Std. Error of Reg.=	0.422923E-01
Log(likelihood) =	42.3140	Durbin-Watson =	1.46300
Schwarz Criterion =	36.0430	F (3, 19) =	4.91456
Akaike Criterion =	38.3140	Significance =	0.010791

Regression (8)

REGRESS: dependent variable is Log (Real Private Investment/ Real GDP)

Using 1970 - 1988

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	-2.08120	0.415038E-01	-50.1449	0.000
user cost of capital[8]	-1.70804	0.588792	-2.90092	0.010

Equation Summary

No. of Observations =	19	R2= 0.3311 (adj)=	0.2918
Sum of Sq. Resid. =	0.209058	Std. Error of Reg.=	0.110894
Log(likelihood) =	15.8812	Durbin-Watson =	1.56057
Schwarz Criterion =	12.9368	F (1, 17) =	8.41535
Akaike Criterion =	13.8812	Significance =	0.009943

The semi-logarithmic elasticity of private investment with respect to the user cost of capital is quite high at 1.7. As pointed out before, the ratio of real private investment to GDP shows a secular decline, which is only partially explained by this equation since the decline began before the start of this sample period. The user cost of capital has risen over time, both because of a rise in the real loan interest rate (figure 5) and an increase in the relative price of capital goods (figure 7). As noted above, the rise in the real interest rate took place mainly in the 1980's and may have been related to the large fiscal deficits of that period.

Real consumption is specified as a function of lagged consumption and real disposable income. This specification allows either the permanent income or Keynesian liquidity-constrained hypotheses to hold. The lagged consumption term is consistent with the permanent income hypothesis, since it reflects all

---

[8] user cost of capital = investment deflator/GDP deflator * real loan interest rate

information about permanent income that was available last period. The disposable income term both reflects new information about permanent income and is the relevant variable for liquidity-constrained consumers in the economy. We tested other variables suggested in the proposal, such as real interest rates, government consumption, and the stock of money, but found them all to be insignificant. Real disposable income is defined as nominal income less government revenues net of subsidies and less the inflation tax on money balances, deflated by the consumption deflator. The inflation tax is defined as the inflation rate in terms of the consumer price deflator times the lagged money base.[9]

Regression (9a) shows the estimated results. Two-stage least squares is used to take into account the simultaneity between consumption and current income. We can see that the sum of the estimated coefficients is close to one, which would imply that consumption is proportional to disposable income in the long run. A formal test of this restriction fails to reject it; accordingly it is imposed in Regression (9b). Both the restricted and unrestricted regressions show a strong effect of current disposable income. It seems unlikely this would reflect only new information about permanent income--liquidity constraints on consumers must be quite important. This is consistent with the results of Cuddington (1989), who found a higher propensity to consume out of temporary rather than permanent income, and in contrast to the results of Clavijo (1989), who tends to confirm the permanent income hypothesis.

---

[9]The "tax rate" actually must be defined as the inflation rate over one plus the inflation rate to constrain the "tax rate" between zero and one.

Regression (9a)

TWOSLS: dependent variable is Log of Real Private Consumption (Cp)

Using 1971 - 1986

Exogenous Variables

constant, lagged consump (DV), log (gov't consump), exports, disposable income

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	0.472775	0.429891	1.09975	0.291
lagged consumption	0.490119	0.223008	2.19776	0.047
ln disposable income	0.477914	0.243768	1.96052	0.072

Equation Summary

No. of Obs. = 16	R2= 0.997 (adj)= 0.996	Durbins H= -0.73675	
Sum of Sq. Resid. =	0.189280E-02	Std. Error of Reg.=	0.120665E-01
Log(likelihood) =	49.6353	Durbin-Watson =	1.91136
Schwarz Criterion =	45.4764	F (2, 13) =	1946.06
Akaike Criterion =	46.6353	Significance =	0.000000

Regression (9b)

TWOSLS: dependent variable is log(Cp) - log(Cp(-1))

Using 1971 - 1986

Exogenous Variables

constant, lagged consump, gov't consump, exports, disp income

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	-0.564652E-01	0.207139E-01	-2.72595	0.016
log real disposable income - log (Cp-1)	0.724066	0.151318	4.78507	0.000

Equation Summary

No. of Observations = 16	R2= 0.6604 (adj)= 0.6361		
Sum of Sq. Resid. =	0.239054E-02	Std. Error of Reg.=	0.130673E-01
Log(likelihood) =	47.7676	Durbin-Watson =	1.58501
Schwarz Criterion =	44.9950	F (1, 14) =	27.2235
Akaike Criterion =	45.7676	Significance =	0.000130

The final behavioral equation is that for overall GDP growth. Output per worker is specified as a function of the stocks of public and private capital per worker. To capture the cyclical behavior of output, we model the error term from this equation as an AR(2) process. This implies that the underlying trend of output will be given by the evolution of capital stocks, while actual output will follow a cycle around this trend. The regression is estimated over t... period 1927-88, with a dummy for the years of World War 2, as shown in regression 10. The results show a strong effect of public capital on output, with an elasticity of almost .5. The sum of the elasticities of output with respect to public and private capital is greater than one, in contrast to the conventional

Regression (10)

LS // Dependent Variable is Ln (Output per worker)
Date: 6-06-1990 / Time: 11:27
SMPL range: 1927 - 1988
Number of observations: 62
Convergence achieved after 2 iterations

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-1.2678325	0.3694451	-3.4317208	0.001
Private cap stk per worker	0.7000028	0.0964987	7.2540151	0.000
Public cap stk per worker	0.4787963	0.0684088	6.9990441	0.000
DUMWAR	-0.0306359	0.0159174	-1.9246792	0.059
Error term (-1)	1.3973519	0.1061180	13.167912	0.000
Error term (-2)	-0.6036747	0.1054786	-5.7231941	0.000

R-squared	0.997269	Mean of dependent var	6.427988
Adjusted R-squared	0.997025	S.D. of dependent var	0.431955
S.E. of regression	0.023559	Sum of squared resid	0.031081
Durbin-Watson stat	1.971940	F-statistic	4090.208
Log likelihood	147.5732		

neoclassical Cobb-Douglas production function in which the elasticity of output with respect to total capital is well below one. Thus, strong increasing returns are implicit in these results, although this equation is not intended as a rigorous test of returns to scale.

The other matter that must be addressed is the spread between loan and deposit interest rates, since the former enters into investment and the latter into money and quasimoney demands. We assume that the spread between deposit rate i_D and loan rate i_L is explained by the reserve requirement (r) and an exogenous component i_o, which would include profits and other costs of intermediation:

$$(10) \qquad i_D = i_L(1-r) - i_o$$

If we write the nominal loan rate as the sum of the real loan rate and the inflation rate, then the nominal deposit rate can be written as a function of the real loan rate and inflation as follows:[10]

$$(11) \qquad i_D = (1-r)(r_L + \pi) - i_o$$

while the real deposit rate will be given as:

$$(12) \qquad i_D - \pi = (1-r)\, r_L - r\pi - i_o$$

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[10]Actual inflation is used throughout as a measure for expected inflation. This implies static expectations--the current inflation is expected to continue. In the analysis of the model below, this implies that the inflation argument underlying money and quasimoney demands changes whenever the current price level changes.

We can now substitute into the equilibrium relations (2) and (4) to determine the equilibrium response of real interest rates and inflation to changes in government money and domestic debt financing. Equation (13) shows the equilibrium relation between changes in central bank credit to the government L_{cg}, inflation rate π, and real loan rate, r_L:

$$(13) \qquad dL_{cg} = \left[P \cdot M1 \; (c+r(1-c)) \left[\frac{1}{1+\pi} + \frac{M1'}{M1} (1-r) \right] \right.$$

$$\left. + r \; P \cdot QM \left[\frac{1}{1+\pi} - r \frac{QM'}{QM} \right] \right] d\pi$$

$$+ \left[P(1-r) \left[\frac{M1'}{M1} \; (c+r(1-c)) \; M1 + r \frac{QM'}{QM} QM \right] \right] dr_L$$

An increase in inflation will be associated with more monetary financing of the deficit as long as we have not passed the maximum point of the inflation tax Laffer curve. The first expression in (13) says that an increase in inflation is associated with less real demand for money and quasimoney, but a higher nominal flow of financing. The second effect is stronger than the first as long as we are on the upward sloping part of the Laffer curve.

We can analyze the inflation tax-maximizing inflation rate using the estimated equations of the model. A simulation of the money and quasimoney demand equations at different inflation rates shows the relationship between the inflation rate and seignorage revenue shown in figure 16. We see that maximum

seignorage (defined as the change in the money base over nominal GDP) of about 2.7 percent of GDP is achieved at inflation of a little less than 100 percent. This should not be taken too seriously since the hypothesized maximizing inflation rate lies well outside of the range observed in the sample period for the money and quasimoney regressions. It is clear, however, that historically inflation has been well below the seignorage-maximizing rate.

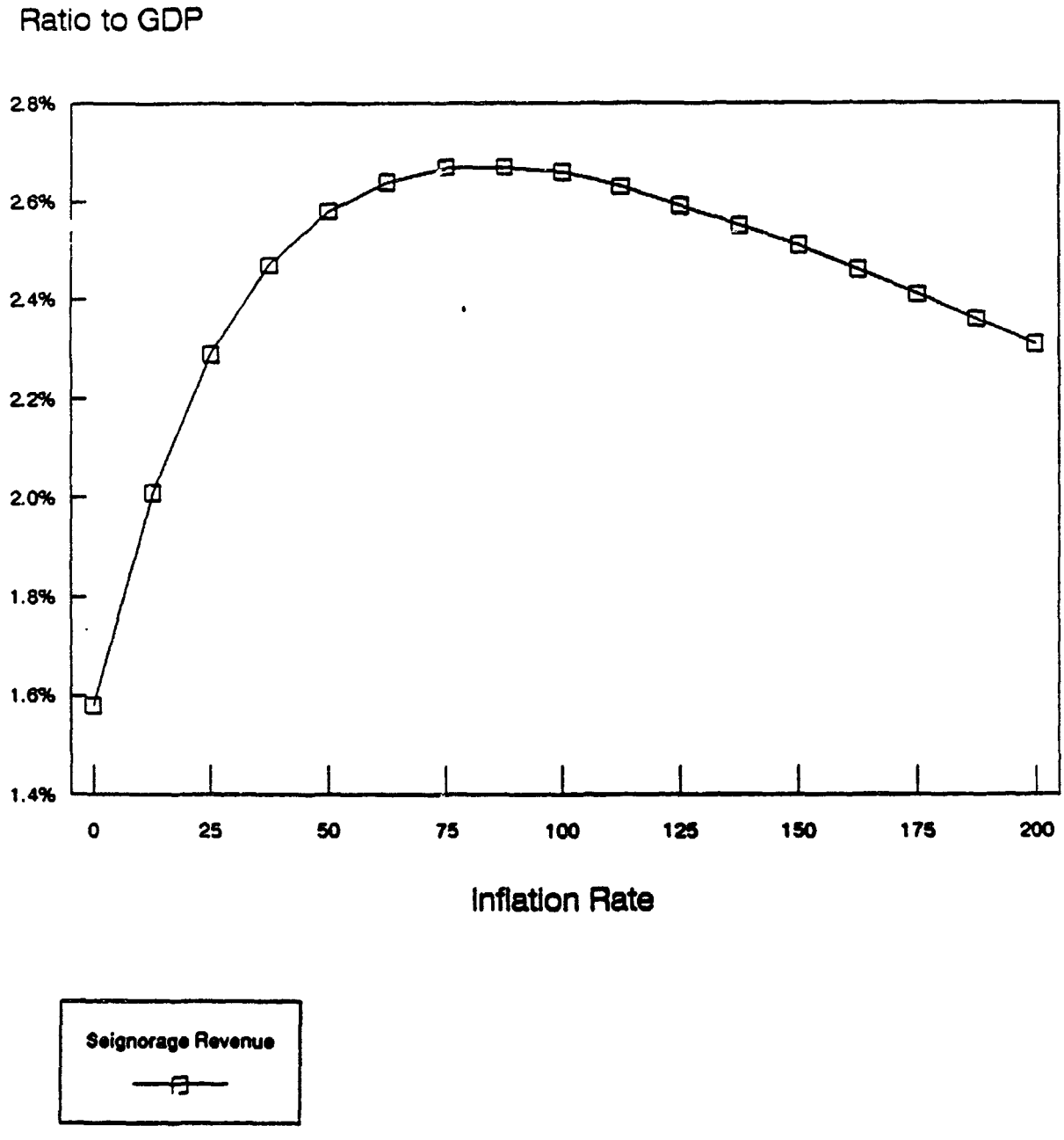
The effect of a higher real interest rate on money creation is ambiguous. This is because higher interest rates have an ambiguous effect on the demand for base money -- they lower demand for narrow money but raise demand for quasimoney, and base money is a linear combination of the two (with the coefficients given by the currency to M1 ratio and the reserve ratio). Base money is more likely to rise in response to a real interest rate increase the higher is the interest rate elasticity of quasimoney demand relative to money demand, and the higher is the ratio of existing quasimoney to M1. Thus, equilibrium in the money market could imply either a negative or positive relationship between the real loan interest rate and the inflation rate for given stock of central bank credit to the government.

Equation (14) shows the equilibrium relation in the credit market between real bank credit to the government Ldg/P, inflation π, and the real loan interest rate r_L.

$$(14) \qquad d\left[\frac{L_{dg}}{P}\right] = \left[(1-r)^2\ (1-c)\ M1' - r(1-r)(1-z)\ QM'\right] d\pi$$

$$+ \left[(1-r)^2\ (1-c)\ M1' + (1-r)^2\ (1-z)\ QM' - \gamma I_p'\right] dr_L$$

Figure 16
Seignorage Revenue
as a function of the inflation rate

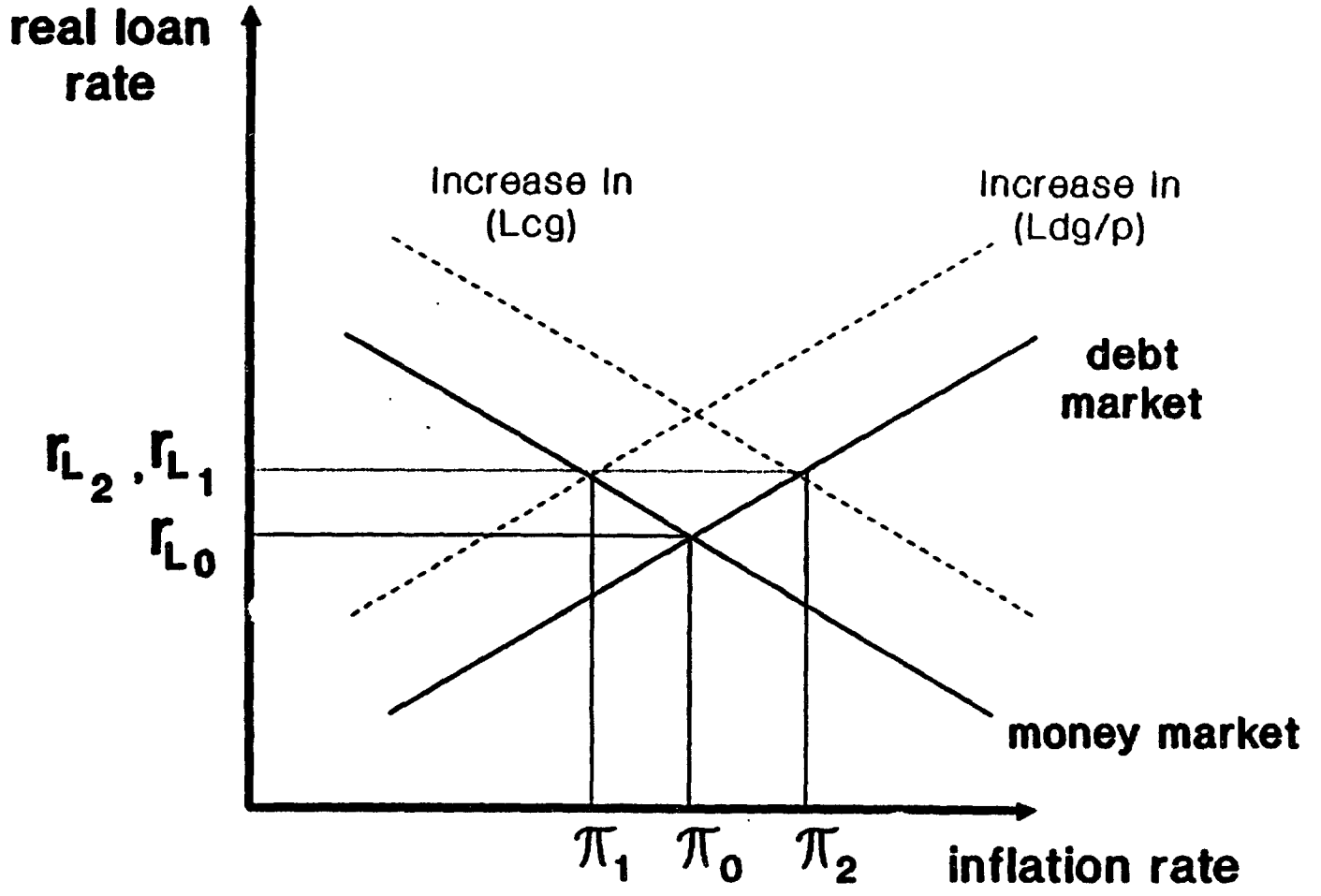


An increase in the real interest rate increases credit to the government because it reduces private investment and credit demand and because it increase deposits in the banking system.[11] Higher inflation reduces credit to the government, because a higher inflation rate for a given real loan interest rate implies a lower real deposit rate (from (12)). Thus, quasimoney demand is reduced by higher inflation. Demand deposits are also reduced, since these are a function of nominal interest rates. Thus, equilibrium in the credit market for a given stock of government debt implies a positive relationship between the real loan rate and inflation.

Figures 17 and 18 show the joint determination of the real loan interest rate and inflation in the money and credit markets. The case where the money market equilibrium implies a negative relationship between the real interest rate and inflation is shown in Figure 17. The locus of debt equilibria is always upward sloping. An increase in government borrowing shifts up the locus of debt equilibria. This implies a higher real interest rate (r_{L1}) and a lower rate of inflation (π_1). The higher inflation is because the demand for base money is increased by higher real interest rates, which implies a lower price level (and rate of inflation) for a given supply of money base. An increase in central bank credit to the government increases the money base, which shifts up the money market equilibrium curve. Both inflation and the real interest rate increase (r_{L2} and π_2). The real interest rate increases because higher inflation represents a tax on demand and quasimoney deposits for given real loan rate, so

[11]There is also the small negative effect of a decrease in demand deposits in the banking system, so technically we must require that this effect be dominated by the quasimoney and investment effects.

Figure 17


real loan rate
Increase in (Lcg)
Increase in (Ldg/p)
debt market
r_{L_2}, r_{L_1}
r_{L_0}
money market
π_1 π_0 π_2
inflation rate

that deposits would tend to fall unless there is an offsetting rise in interest rates.

Figure 18 shows the case where the locus of money market equilibria is upward sloping. An increase in government borrowing now causes the inflation rate to increase as well as the real loan rate. The higher real loan rate causes the demand for money base to fall, which causes inflation to rise for a given supply of money base. An increase in central bank credit to the government still causes an increase in interest rates and inflation, for the same reasons as before. Although both domestic borrowing and money creation cause real interest rates and inflation to increase, it is clear from the graph that the debt financing has a much stronger effect on real interest rates and a much weaker effect on inflation.

3. Simulation results

We use the model to perform counterfactual simulations within and beyond the sample period. We first calibrate the exogenous variables to reproduce the observed inflation and real interest rate over the period 1987-89.[12] This period is a mixture of within-sample and out-of-sample observations, since various regressions end in 1986, 1987, or 1988. We then consider changes in the fiscal deficit and its financing to evaluate how the deficit translates into changes in inflation and interest rates.[13]

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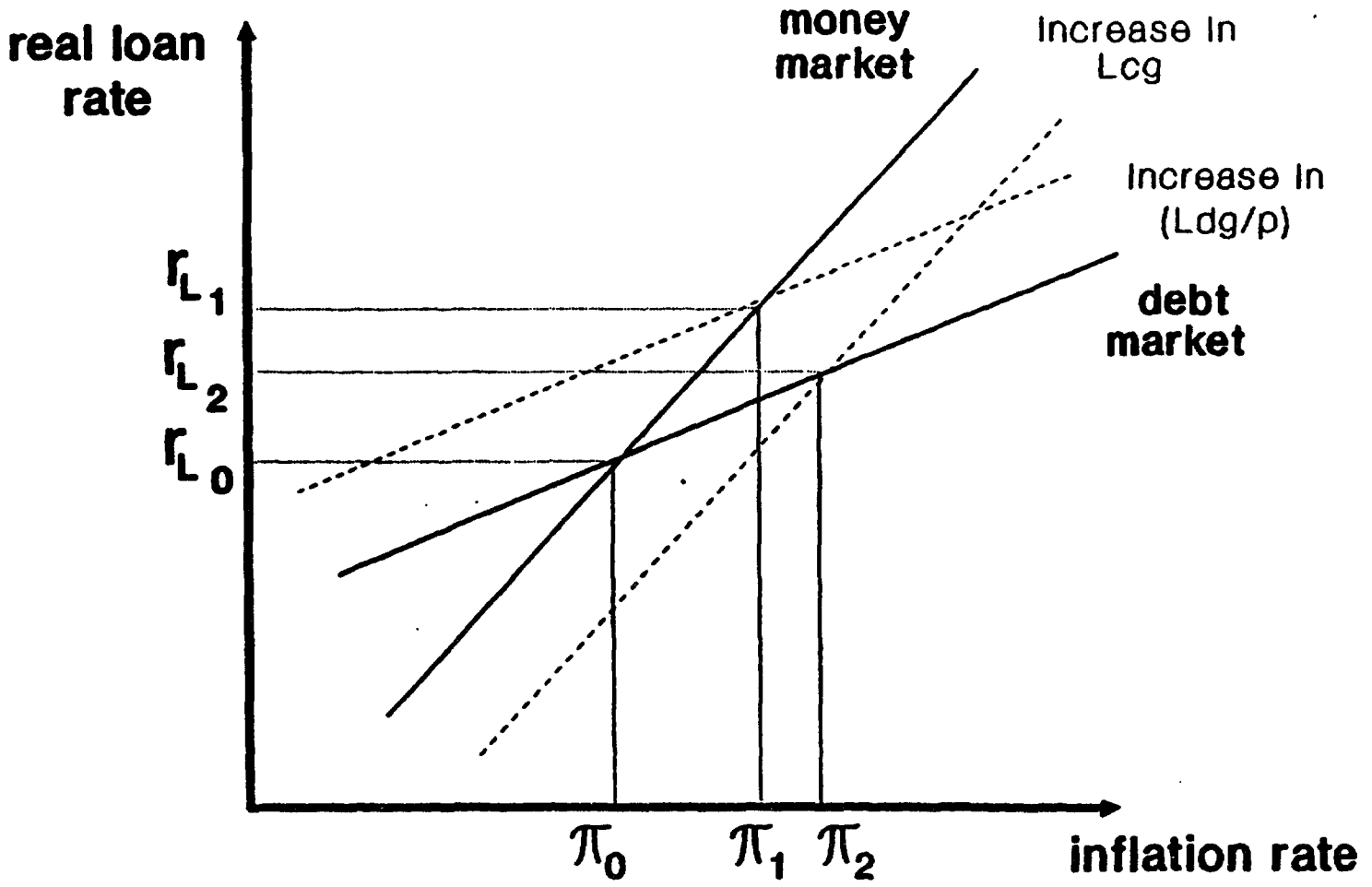
[12]The exogenous variables Othc and Othd are adjusted to reproduce the actual equilibrium in the money and credit markets. All other exogenous variables retain their actual or estimated values over 1987-89.

[13]Several of the regression equations set out above have lagged error terms on the right-hand side. These are included in the model that is simulated here.

Figure 18


real loan rate
money market
Increase in Lcg
Increase in (Ldg/p)
debt market
r_{L_1}
r_{L_2}
r_{L_0}
π_0
π_1
π_2
inflation rate

The first simulation, shown in Table 5 as differences from the base case, is an increase in public investment financed by domestic borrowing. The fiscal expansion of 1.2 percent of GDP in 1987, .8 percent in 1988 and .9 percent in 1989 results in a real interest rate increase of 3 percent in 1987-88 and 5 percent in 1989.[14] The rise in the real interest rate causes a drop in the ratio of private investment to GDP of .5 percent in 1987-88 and .8 percent in 1989. However, this is not as great as the increase in public investment, so growth increases by .4 percentage points in 1988 and .2 percent in 1989.

As pointed out above, the effect of a debt-financed fiscal expansion on inflation is ambiguous. In this simulation, there is a slight increase the first year, a fall in inflation the second year, and an increase the third year. The complicated pattern results from several offsetting factors. The increases in growth in 1988 and 1989 tend to lower inflation, because higher growth stimulates greater demand for money, implying a lower rate of inflation for a given amount of money creation. However, the increased interest rates have two offsetting effects on demand for base money -- a positive effect on reserves on quasimoney and a negative effect on demand for currency and on reserves on demand deposits.

This simulation can be interpreted counterfactually as what would have happened if the fiscal adjustment described above had not taken place. Thus, the difference between this simulation and the actual outcome represent the consequences of adjustment as compared to continuing debt-financed fiscal

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[14]The reason for the round number for the change in the real interest rate is that the simulation is actually run the other way around--by specifying an increase in the real interest rate and then calculating the change in inflation and the deficit consistent with an unchanged level of monetary financing. This greatly simplifies the computation, while the economic interpretation of the simulation remains the same.

Table 5

CASE OF INCREASED PUBLIC INVESTMENT
FINANCED BY DOMESTIC BORROWING

Differences from Base Case

Ratios to GDP	1987	1988	1989
National Accounts (real)			
Private Consumption	-0.01%	-0.01%	-0.11%
Private Investment	-0.50%	-0.51%	-0.82%
Public Investment	1.21%	0.77%	0.86%
Disposable Income	-0.01%	0.10%	-0.13%
Capital Stock			
Public	0.00%	0.80%	1.81%
Private	0.00%	-0.97%	-1.51%
Monetary Accounts			
Stocks			
Money	-0.23%	0.13%	-0.55%
Quasimoney	0.37%	0.40%	0.62%
Money Base	-0.01%	0.17%	-0.06%
International Reserves	-0.02%	0.19%	-0.09%
Public Sector Deficit	1.21%	0.77%	0.86%
Public Deficit Financing Flows			
Foreign	0.00%	-0.01%	0.00%
Central Bank	0.00%	0.00%	0.00%
Rest of Financial System	1.21%	0.77%	0.86%
Other Liabilities of Govt.	0.00%	0.00%	0.00%
Stock of Credit from:			
Central Bank to Govt.	0.00%	0.06%	-0.02%
Rest of Fin'l System to Govt.	1.20%	1.69%	2.03%
Rest of Fin'l System to Private	-0.23%	-0.45%	-0.64%
Other Variables Absolute Changes			
GDP growth	0.00%	0.44%	0.16%
Inflation	0.28%	-3.40%	3.75%
Interest rates:			
Loan Rate	4.01%	-0.03%	10.77%
Real Loan Rate	3.00%	3.00%	5.00%
Deposit Rate	3.57%	-0.03%	9.52%
Real Deposit Rate	2.57%	2.80%	4.26%

expansion. We see that the fiscal adjustment had the effect of lowering growth, but increasing private investment and lowering real interest rates. This effect on growth is only meaningful in the medium-run, however, since a debt-financed fiscal expansion is not sustainable indefinitely; it would be better to say that a decrease in growth took place now rather than later. It also must be clarified that the decrease in growth occurs only because of decreased public investment; fiscal adjustment through reducing public consumption would have a positive growth effect because the only effect would have been private investment stimulated through lower real interest rates.

Table 6 shows the results of a simulation of an increase in public investment financed by money creation. An increase in inflation of 15 percentage points per year is triggered by higher ratios to GDP of public investment and public deficit of .2 percent in 1987 and 1.1 percent in 1988-89. The reason a lower deficit increase leads to the same inflation rate in the first year as that associated with higher deficits in the second two years is the portfolio shift effect. An increase in inflation causes a one-time shift out of money, which sharply decreases the amount of money financing available in the first period. In the succeeding periods, the quantity of money demanded grows in accordance with the new rate of inflation, without any offsetting portfolio shift.

The money-financed increase in public spending raises the real interest rate initially, as predicted by the comparative statics set out above. This is because of the higher inflation tax on deposits for a given real loan rate, which requires an increase in the interest rate to increase deposits again and maintain equilibrium. The higher real interest rates have a slight negative effect on private investment. However, this is more than offset by the increase in public investment, so that by 1989 growth is .6 percent higher than in the base case.

Table 6

CASE OF INCREASED PUBLIC INVESTMENT
FINANCED BY MONEY CREATION

Differences from Base Case

Ratios to GDP	1987	1988	1989
National Accounts (real)			
Private Consumption	-0.21%	-0.18%	-0.33%
Private Investment	-0.32%	-0.12%	0.05%
Public Investment	0.23%	1.14%	1.10%
Disposable Income	-0.32%	-0.20%	-0.27%
Capital Stock			
Public	0.00%	0.25%	0.83%
Private	0.00%	-0.25%	-1.02%
Monetary Accounts			
Stocks			
Money	-1.09%	-0.56%	-0.35%
Quasimoney	0.12%	0.01%	-0.12%
Money Base	-0.47%	-0.26%	-0.20%
International Reserves	-1.03%	-1.89%	-2.64%
Public Sector Deficit	0.23%	1.14%	1.10%
Public Deficit Financing Flows			
Foreign	0.00%	0.00%	0.00%
Central Bank	0.23%	1.14%	1.11%
Rest of Financial System	0.00%	0.00%	0.00%
Other Liabilities of Govt.	0.00%	0.00%	0.00%
Stock of Credit from:			
Central Bank to Govt.	-0.01%	0.91%	1.55%
Rest of Fin'l System to Govt.	-0.08%	-0.13%	-0.22%
Rest of Fin'l System to Private	-0.15%	-0.15%	-0.29%
Other Variables Absolute Changes			
GDP growth	0.00%	-0.05%	0.62%
Inflation	15.00%	15.00%	15.00%
Interest rates:			
Loan Rate	19.64%	17.73%	16.52%
Real Loan Rate	1.94%	0.71%	-0.30%
Deposit Rate	17.46%	15.67%	14.60%
Real Deposit Rate	0.86%	0.06%	-0.85%

Table 7

CASE OF SUBSTITUTING MONEY CREATION FOR DEBT FINANCING

Differences from Base Case

Ratios to GDP	1987	1988	1989
National Accounts (real)			
Private Consumption	-0.21%	-0.17%	-0.27%
Private Investment	-0.23%	0.43%	0.90%
Public Investment	0.00%	0.00%	0.00%
Disposable Income	-0.32%	-0.21%	-0.27%
Capital Stock			
Public	0.00%	0.10%	-0.12%
Private	0.00%	-0.06%	0.08%
Monetary Accounts			
Stocks			
Money	-1.05%	-0.80%	-0.12%
Quasimoney	0.05%	-0.41%	-0.88%
Money Base	-0.47%	-0.26%	-0.25%
International Reserves	-1.03%	-1.89%	-2.62%
Public Sector Deficit	0.00%	0.00%	0.00%
Public Deficit Financing Flows			
Foreign	0.00%	0.00%	0.00%
Central Bank	0.23%	1.14%	1.04%
Rest of Financial System	-0.23%	-1.14%	-1.04%
Other Liabilities of Govt.	0.00%	0.00%	0.00%
Stock of Credit from:			
Central Bank to Govt.	-0.01%	0.90%	1.48%
Rest of Fin'l System to Govt.	-0.31%	-1.42%	-2.10%
Rest of Fin'l System to Private	-0.11%	0.06%	0.18%
Other Variables Absolute Changes			
GDP growth	0.00%	-0.13%	0.29%
Inflation	15.00%	15.00%	15.00%
Interest rates:			
Loan Rate	18.85%	12.80%	9.85%
Real Loan Rate	1.36%	-2.73%	-4.99%
Deposit Rate	16.75%	11.31%	8.70%
Real Deposit Rate	0.37%	-2.98%	-5.00%

The growth fuels greater demand for deposits, so that the real interest rate can actually fall in 1989 compared to the base case.

The higher inflation also has a small negative effect on private consumption. Higher inflation increases the inflation tax on money balances, decreasing after-tax disposable income of consumers.

Interpreting the simulation counterfactually, it would imply that the fiscal adjustment of the 1980's as compared to continuing money-financed fiscal expansion had the effect of lowering inflation, increasing private consumption and investment, but decreasing growth. Again, the effect on growth could have been avoided simply by making the locus of fiscal adjustment public consumption rather than public investment.

The final simulation we consider is a substitution of money for debt financing, leaving the deficit unchanged as shown in Table 7. The increase in money financing of .2 percent in 1987 and 1.1 percent in 1988-89 is again associated with increased inflation of 15 percent per year. The effect on the real interest rate is ambiguous, with offsetting effects of an increased inflation tax on deposits and a fall in government borrowing requirements. In the first year, the fall in government borrowing is small, so the increased inflation tax dominates, raising the real loan rate by 1.3 percent. In the second and third years, the larger fall in government borrowing dominates, so that the real interest rate falls 3 and then 5 percent.

The fall in real interest rates implies a rise in private investment by .9 percent of GDP by 1989. Private consumption again falls because of the increased inflation tax. Substituting money for debt finance is favorable for saving and growth. However, again we must be cautious in interpreting this

result. The efficiency losses associated with inflation are not captured by the model; they could well dominate the results given here.

IV. THE REAL EXCHANGE RATE AND THE FISCAL DEFICIT

The model of this section emphasizes that the real exchange rate is not just the outcome of exchange rate policy by the government. Rather, it reflects endogenous economic forces that affect the demands and supplies for tradable and nontradable goods. The fiscal deficit is especially important among these, since it represents net demand pressure that is policy-induced. This is particularly clear in Colombia, where a corner-piece of the adjustment program since 1985 has been a substantial devaluation of the peso. This was achieved without a large acceleration of inflation, which has to do with the substantial fiscal adjustment that accompanied it. It will be argued in this section that changes in fiscal policy have been a dominant influence on the real exchange rate and have helped to offset the effect of terms of trade shifts.

1. Determination of the real exchange rate

It will be helpful first of all to set out the theoretical relationship between the real exchange rate and the resource balance. This paper follows closely the methodology given in the research proposal, which is presented in detail in Rodriguez (1989).[15] The approach envisions 3 goods in the economy: nontradables, importables, and exportables. If we think of importables as the numeraire, then the relative price of nontradables is the real exchange rate, while the relative price of exportables is the terms of trade. The real exchange

---

[15]For an interesting alternative approach to the real exchange rate in Colombia, see Clavijo (1990).

rate is determined from the equilibrium condition in the market for nontradable goods. Assuming no excess capacity or cyclical unemployment, the supply of such goods must equal the demand. The demands and supplies in this market will be affected by the resource balance, the terms of trade, and government spending. The resource balance will be shown in the next section to be a variable exogenous to the real exchange rate, determined by the excess of investment over saving.

a. Theoretical determination of the real exchange rate

For convenience, we reproduce here the model of Rodriguez, with some minor modifications and extensions. The supply of nontradables is given by the following:

$$(1) \qquad Y_n = a(\overset{+}{em}, \overset{+}{ex})\ Y$$

where em, the relative price of importables, and ex, the relative price of exportables are given as follows:

$$(2) \qquad em = \frac{P_N}{EP^*_m}$$

$$(3) \qquad ex = \frac{P_N}{EP^*_x} = \frac{P_N}{EP^*_m} \quad \frac{P^*_m}{P^*_x} = em/tt$$

We can thus rewrite the supply of nontradables as a function only of the real exchange rate (defined in terms of importables and rechristened e) and the terms of trade, tt:

$$(4) \qquad Y_n = a(\overset{+}{e},\ \overset{-}{tt})\ Y$$

As shown, the supply of nontradables is a positive function of the real exchange rate (where appreciation is up) and a negative function of the terms of trade. This latter effect is because an improvement in the terms of trade draws resources towards the exportables sector, in standard Dutch disease fashion.

The demand for nontradables by the private sector can also be given as a (negative) function of the relative price of nontradables relative to both importables and exportables, as well as total private spending Gp:

$$(5) \qquad G_{pn} = b(\overset{-}{em},\ \overset{-}{ex})\ G_p$$

Using (2) and (3) again, we can rewrite this as:

$$(6) \qquad G_{pn} = b(\overset{-}{e},\ \overset{+}{tt})\ G_p$$

so that demand for nontradables is a negative function of the real exchange rate (i.e. will go down with a real appreciation) and a positive function of the terms of trade. The latter effect is because an increase in the terms of trade shifts

demand away from the exportables sector towards the nontradables sector, for given import prices.

Government spending on nontradables is given as a fixed fraction (b_g) of government consumption, which in turn is a constant share of output g:

$$(7) \qquad G_{gn} = b_g . g . Y$$

The condition that demand of nontradables equal the supply can be given as follows:

$$(8) \qquad b(\bar{e},\ t\bar{t})\ (G - gY) + b_g .\ gY = a(\overset{+}{e},\ t\bar{t})Y$$

where G is total expenditure in the economy. By definition, G is equal to income minus the resource balance (surplus in trade of goods and nonfinancial services), so we can write it as follows:

$$(9) \qquad G = (1-ts)\ Y$$

where ts is the ratio of the resource balance to GDP. We can then rewrite (8) as:

$$(10) \qquad b(\bar{e},t\bar{t})\ (1-ts-g) + b_g g \ = a(\overset{+}{e},\ t\bar{t})$$

Taking the total derivative of (10), we can get an expression for the change in e as a function of the changes in the exogenous variables:

$$(11) \qquad d(e) = \frac{(b_2(1-ts-g) - a_2)\, d(tt) - b\, d(ts) + (b_g - b)\, d(g)}{a_1 - b_1\,(1 - ts - g)}$$

The real exchange rate is a negative function of the terms of trade (for given import prices). An increase in the terms of trade shifts supply away from nontradables and demand towards nontradables, so the real exchange rate appreciates. The real exchange rate is also a negative function of the trade surplus. An increase in the trade surplus decreases spending relative to income. This lowers demand for nontradables, so their relative price falls (there is a real depreciation).

The real exchange rate is an ambiguous function of the level of government spending. An increase in government spending for a given resource surplus (and thus given level of total spending) implies a redistribution of spending from the private to the public sector. If the government has a higher propensity to spend on nontradables than the private sector, then increased government spending implies a net increase in demand for nontradables. This will result in a real appreciation. Conversely, if the government has a lower propensity to spend on nontradables (or to say it another way, a higher propensity to spend on importables and exportables), increased spending will result in real depreciation.

b. Simulation of the real exchange rate, 1975-87

The model discussed above is estimated for Colombia over the period 1967-87. Table 8 shows the results. We include a lagged dependent variable term to represent partial adjustment of the real exchange rate to changes in the fundamentals. All of the variables are significant (although the resource balance is not quite significant at the 5 percent level) and the correct sign. A terms of trade increase leads to an appreciation of the real exchange rate (we now follow the Colombian convention where an increase in the real exchange rate signifies depreciation). An increase in the resource surplus causes a depreciation of the real exchange rate.

The sign on the government expenditure variable is positive, indicating that increased government spending causes a real depreciation. As indicated earlier, the sign is theoretically ambiguous. The sign found here implies that the government devotes a lower share of its spending to nontradables than does the private sector. This confirms conventional wisdom in Colombia that government spending is very import-intensive.

The equation in Table 8 is simulated over the sample period to analyze the determinants of real exchange rate movements over that period. We first simulate the equation using actual values of the independent variables. The difference between the simulated and actual values of the real exchange rate is a residual not explained by our model. We then simulate the model with the independent variables fixed at their 1975 levels. The difference between the first and the second simulation is the change in the real exchange rate since 1975 that is explained by the 3 independent variables. To decompose the explained real exchange rate behavior into the portion attributable to each factor, we simulate the model sucessively with one of the independent variables

TABLE 8

Variables

```
          LN(EXCH_RL)     = log (real exchange rate)
          LN(TTRADE)      = log (terms of trade)
          RSCBAL&GDP      = resource balance (% of GDP)
          LN(EXPTOT&GDP) = log (Total public expenditure: to GDP)
          PRMFSUR&GDP_SP = primary fiscal surplus (%GDP)


TWOSLS : dependent variable is LN(EXCH_RL)
Using     1967   -  1987
Exogenous Variables
------------------
   ^CONST  LN(EXCH_RL(-1))  LN(TTRADE)  RSCBAL&GDP(-1)
LN(EXPTOT&GDP) PRMFSUR&GDP_SP
```

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	1.45218	1.36576	1.06327	.303
LN(EXCH_RL(-1))	.612230	.267986	2.28456	.036
LN(TTRADE)	-.221399	.808159E-01	-2.73955	.015
RSCBAL&GDP	.299868E-01	.146600E-01	2.04548	.058
LN(EXPTOT&GDP)	.421882	.131091	3.21824	.005

Equation Summary			
No. of Observations =	21	R2= .8125 (adj)=	.7656
Sum of Sq. Resid. =	.548271E-01	Std. Error of Reg.=	.585380E-01
Log(likelihood) =	32.6573	Durbin-Watson =	1.83021
Schwarz Criterion =	25.0460	F (4, 16) =	17.3320
Akaike Criterion =	27.6573	Significance =	.000011

taking its actual value and the other two fixed at their 1975 levels. The difference between this simulation and the one in which all variables are fixed is the portion of the change in the real exchange rate since 1975 attributable to the variable factor. Because of the lagged dependent variable, these

simulations will capture not only the current period impact of changes in the independent variables, but also impacts in future periods.

Figure 19 shows the results of this decomposition. Because the real exchange rate equation is in logarithmic terms, the vertical axis roughly corresponds to the percentage deviation since 1975 attributable to each variable. We see that the real exchange rate appreciates strongly through the early 1980's, then depreciates from 1983 to 1987. The initial real appreciation is due mainly to the increase in the terms of trade associated with the coffee boom of 1976-77 (see Figure 20 for behavior of the independent variables).

After that, however, the real appreciation is fueled mainly by the expansion of the resource deficit (which we will see below to be driven mainly by fiscal deficits). The strong depreciation of 1983-87, conversely, is explained mainly through the reversion of the resource deficit to surplus (again associated with reduction of the fiscal deficit).

Another major factor in the real depreciation that is less commonly recognized is the expansion of public spending. The strong increase in public spending resulted in a shift in the composition of demand towards tradable goods. This reduced the demand for nontradables and caused a change in the log of the real exchange rate of .24 relative to 1975. This structural shift needs to be taken into account in discussions of what is a competitive real exchange rate in Colombia.

The residual does not play a major role in explaining the real exchange rate except in a few years. In 1979-80, the exchange rate was about 5 percent more appreciated than can be explained by the exogenous variables. In 1984-85, the real depreciation is somewhat more than can be explained, while in 1987 the fundamentals would have predicted more depreciation than actually

Figure 19

DECOMPOSITION OF THE REAL EXCHANGE RATE
According to Explanatory Factors

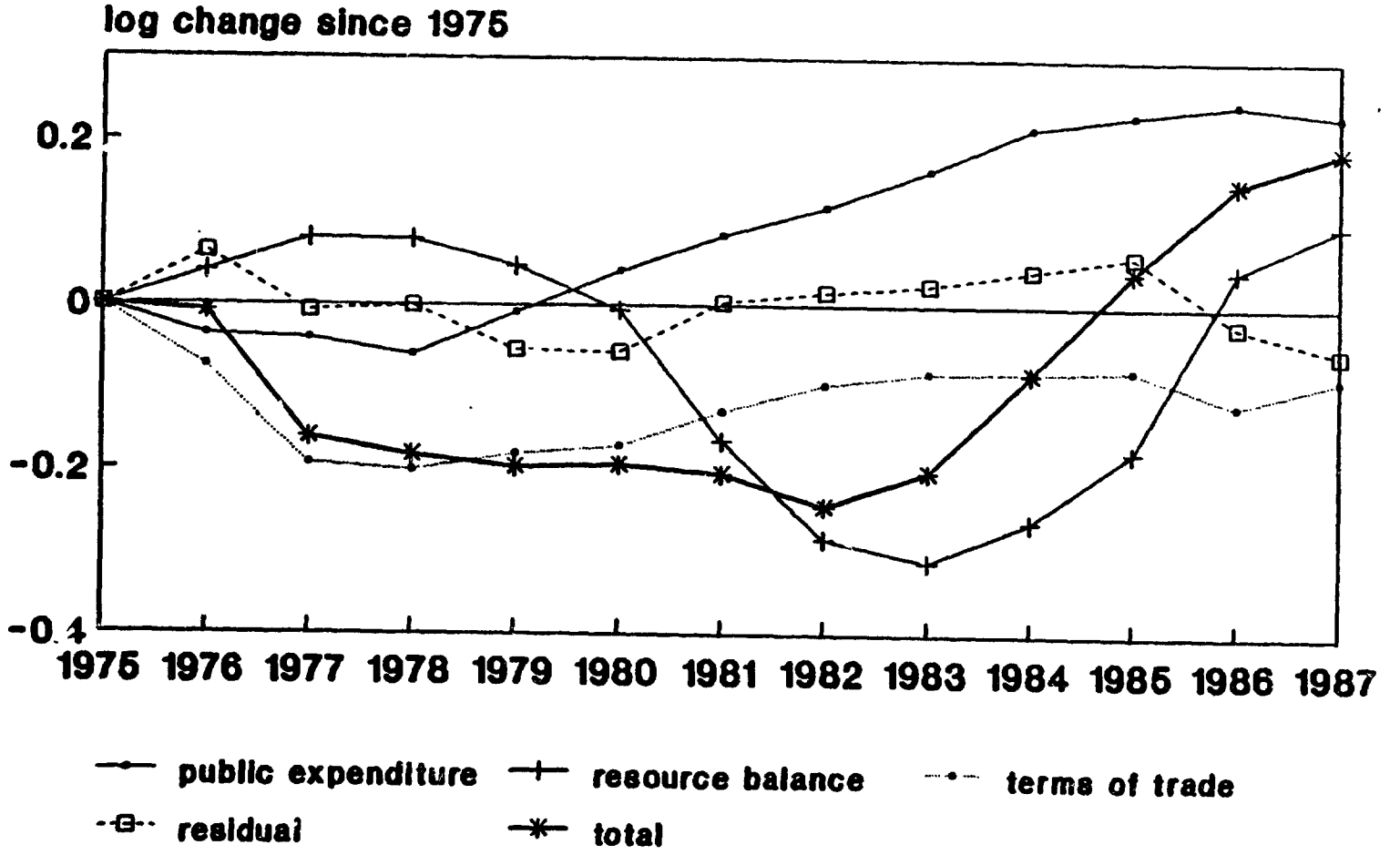
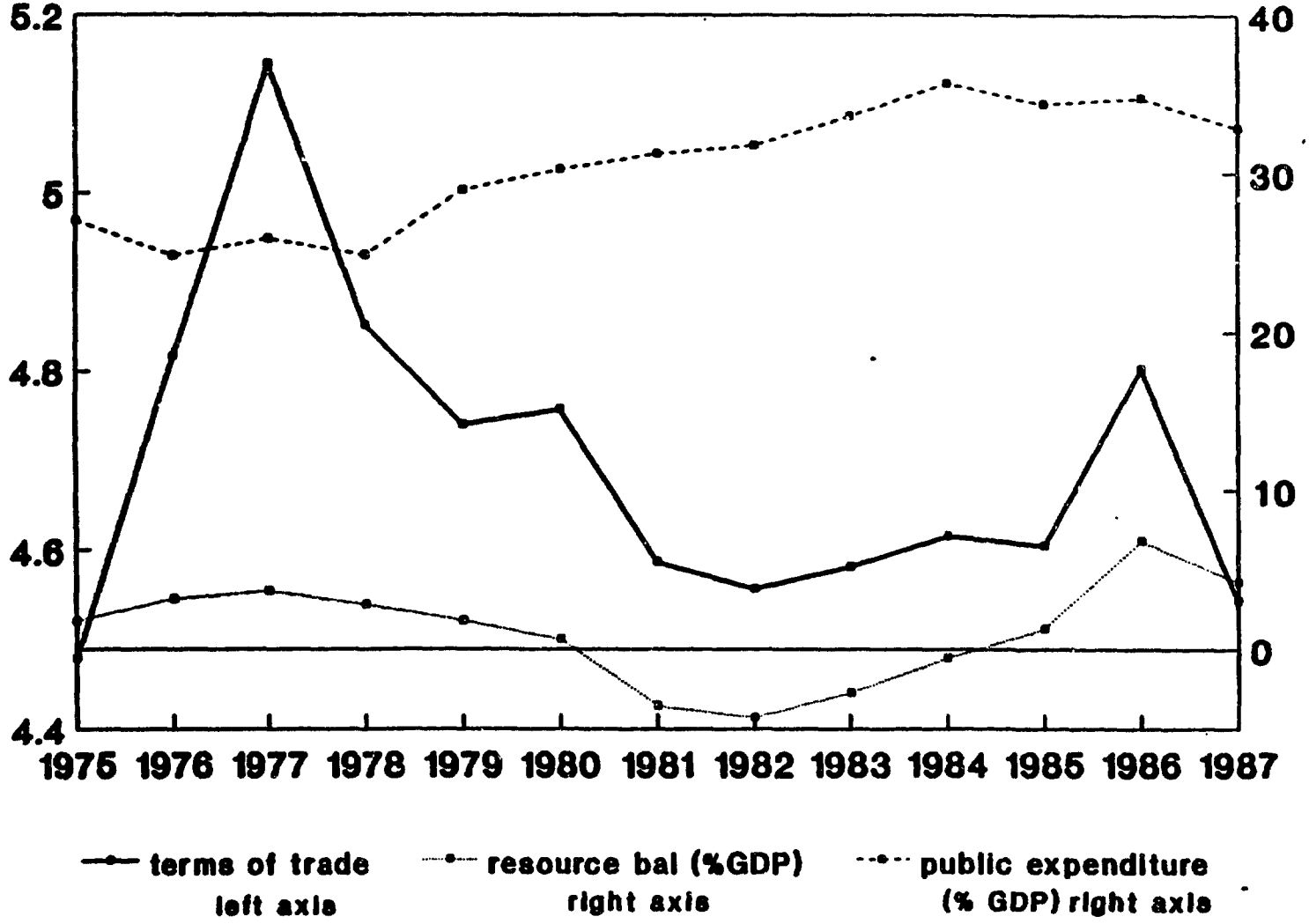


Figure 20

VARIABLES AFFECTING REAL EXCHANGE RATE



occurred. This suggests that there is some margin for managing the realexchange rate in the short run by manipulating the rate of nominal devaluation. Forexample, the large residual in 1985 must reflect a nominal devaluation by the authorities that went beyond what was strictly required by the fundamentals. Of course, all of these estimates have to be taken with a grain of salt given the high standard errors associated with the econometric estimates.

2. Determination of the resource balance

a. Theoretical derivation

The trade surplus is given as the sum of the resource balance of the private sector (saving minus investment) and the primary surplus p of the public sector:

$$(12) \qquad ts = s_p - i_p(r) + p$$

Private investment is a negative function of the real interest rate r. The real interest rate is determined by the equilbrium condition in the market for domestic government debt d_g:

$$(13) \qquad d_g = d_g(\overset{+}{r})$$

The total derivative of (12) gives us the change in the trade surplus as a function of changes in private saving, the real interest rate, and the government primary surplus:

$$(14) \qquad d(ts) = d(s_p) - i_p' dr + dp$$

We will assume in what follows that the derivative of private saving with respect to the real interest rate and the primary surplus is zero. (Ricardian equivalence does not hold).

The real interest rate can be determined from the government financing constraint. The government borrows a fixed amount f from abroad as a percentage of GDP. This is determined exogenously, either as a government policy decision or by international capital market constraints. The residual source of financing is domestic borrowing, which will be given by:

$$(15) \qquad \dot{d}_g = -p - f + (r-g)\, d_g + r^* d_g^*$$

where p is the primary surplus, d_g and d_g^* are domestic and foreign debt, r and r* are domestic and foreign interest rates, and g is the growth rate of GDP. In discrete time, we can write the level of government debt as:

$$(16) \qquad d_g = -p - f + (r-g+1)\, d_g(-1) + r^* d_g^*(-1)$$

The amount of government debt in (16) must equal the amount demanded by the public in (13). Letting r, p, and f vary, this implies the following relationship between r, p and f:

$$(17) \qquad d_g' \, dr = -dp - df + dr\,(d_g(-1))$$

from which we can get r as a function of p and f:

$$(18) \qquad dr = - \frac{-dp - df}{d_g' - d_g}$$

The real interest rate is a negative function of the primary surplus p and a negative function of foreign borrowing f. Either an increase in the surplus or a shift towards foreign borrowing for a given surplus tend to relieve the pressure on domestic financial markets and decrease the interest rate. Since p and f enter symmetrically into the equation for r, this implies that a decrease in p exactly offset by an increase in f will have no effect on r. In other words, an externally-financed fiscal expansion has no effect on domestic interest rates.

Substituting this into (14), we can get the resource balance as a function of the primary surplus and the amount of foreign borrowing:

$$(19) \qquad d\,(ts) = \left[1 + \frac{i_p'}{d_g' - d_g}\right] dp + \frac{i_p'}{d_g' - d_g}\, df$$

The trade surplus is a negative function of foreign borrowing f and a positive function of the primary surplus p (if the coefficient on f is less than one). Note that we have the restriction that the coefficient on p be one plus the coefficient on f. This means that a decrease in p matched exactly by an increase

in f will reduce the resource balance one for one. Since an externally-financed fiscal expansion has no effect on the real interest rate, as shown in the previous paragraph, it can only spill into the resource balance one for one.

We use (19) as the basis for our estimated equation. The results are shown in Table 9. Both variables are statistically significant and the correct sign, and the other regression statistics are satisfactory. The coefficient on p minus the coefficient on f is equal to .86 as opposed to one as predicted by the theory. We can test whether the theoretical restriction is violated by rewriting the regression as shown in Table 10. The coefficient on the external financing variable now has the interpretation of the amount of violation of the linear restriction. We see that this coefficient is not significantly different than zero. Therefore, we cannot reject the hypothesis that this linear combination of coefficients is equal to one.

TABLE 9

Variables

RSCBAL&GDP = resource balance (% of GDP)
PRMFSUR&GDP_SP = primary fiscal surplus (%GDP)
FINEXT&GDP_2 = external financing (%GDP)

REGRESS : dependent variable is RSCBAL&GDP

Using 1970 - 1988

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	2.19633	.507417	4.32845	.001
PRMFSUR&GDP_SP	.448078	.139534	3.21125	.005
FINEXT&GDP_2	-.412757	.157042	-2.62832	.018

Equation Summary

No. of Observations =	19	R2= .6834 (adj)=	.6438
Sum of Sq. Resid. =	51.4009	Std. Error of Reg.=	1.79236
Log(likelihood) =	-36.4144	Durbin-Watson =	1.73298
Schwarz Criterion =	-40.8310	F (2, 16) =	17.2646
Akaike Criterion =	-39.4144	Significance =	.000101

TABLE 10

Variables

DRSCBALSUR = resource balance (%GDP) - primary fiscal surplus (%GDP)
SSURFIN_2 = PRMFSUR&GDP - FINEXT&GDP_2
FINEXT&GDP_2 = external financing (%GDP)

REGRESS : dependent variable is DRSCBALSUR

Using 1970 - 1988

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	2.19633	.507417	4.32845	.001
SSURFIN_2	-.551922	.139534	-3.95548	.001
FINEXT&GDP_2	.139166	.148385	.937869	.362

Equation Summary

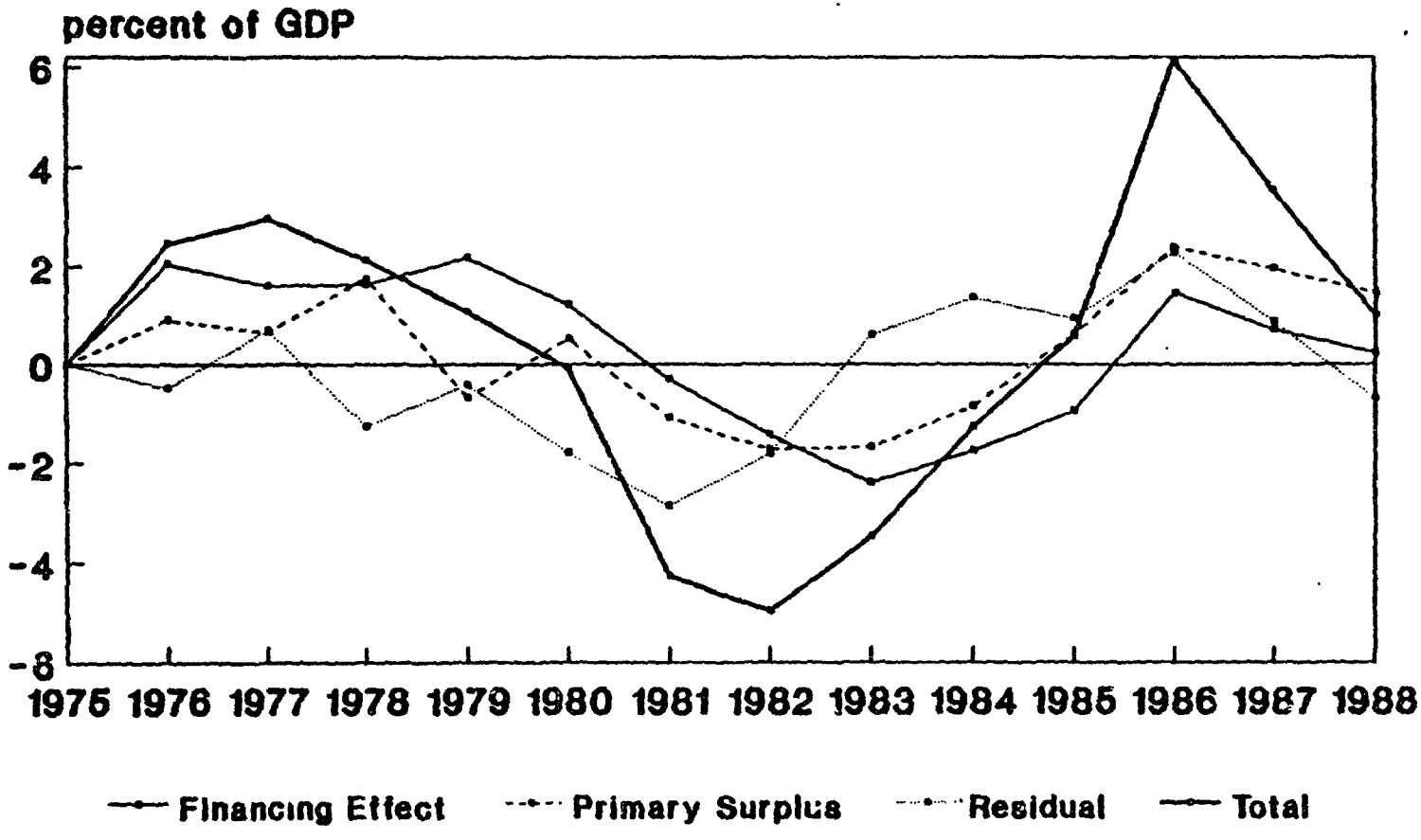
No. of Observations =	19	R2= .5028 (adj)=	.4407
Sum of Sq. Resid. =	51.4009	Std. Error of Reg.=	1.79236
Log(likelihood) =	-36.4144	Durbin-Watson =	1.73298
Schwarz Criterion =	-40.8310	F (2, 16) =	8.09121
Akaike Criterion =	-39.4144	Significance =	.003733

We can use this estimated equation to assess the behavior of the resource balance over the period 1975-88. As we did with the real exchange rate equation, we will do this by simulating the equation for base period (1975) values and compare this to the simulation with actual values of the primary surplus and public external financing. The results are shown in figure 21. The resource balance went from a sizeable surplus in 1977 to a large deficit in 1983, then recovered to yield a surplus again in 1986-88. We see from the graph that the external financing effect is the most important in explaining the resource surpluses of the late seventies, with the exception of the strong effect of the primary surplus in 1978. In the 1980s, the two effects move together. Externally financed fiscal expansion was responsible for the deterioration of

Figure 21

COLOMBIA

Decomposition of the Resource Balance



the resource balance in the early 1980's. Beginning in 1984, fiscal contraction accompanied by reduced foreign borrowing helped improve the resource balance.

The residual does not play a strong role in the behavior of the resource balance except for 1981 and 1986. In those years, large movements in the private resource balance were a major factor. In 1986, this may be due to saving out of the proceeds of the coffee boomlet of that year. It is notable that the residual is not especially large during the bigger coffee boom of 1976-77. To the extent that the coffee boom affected the resource balance in those years, it did so through public sector finances.

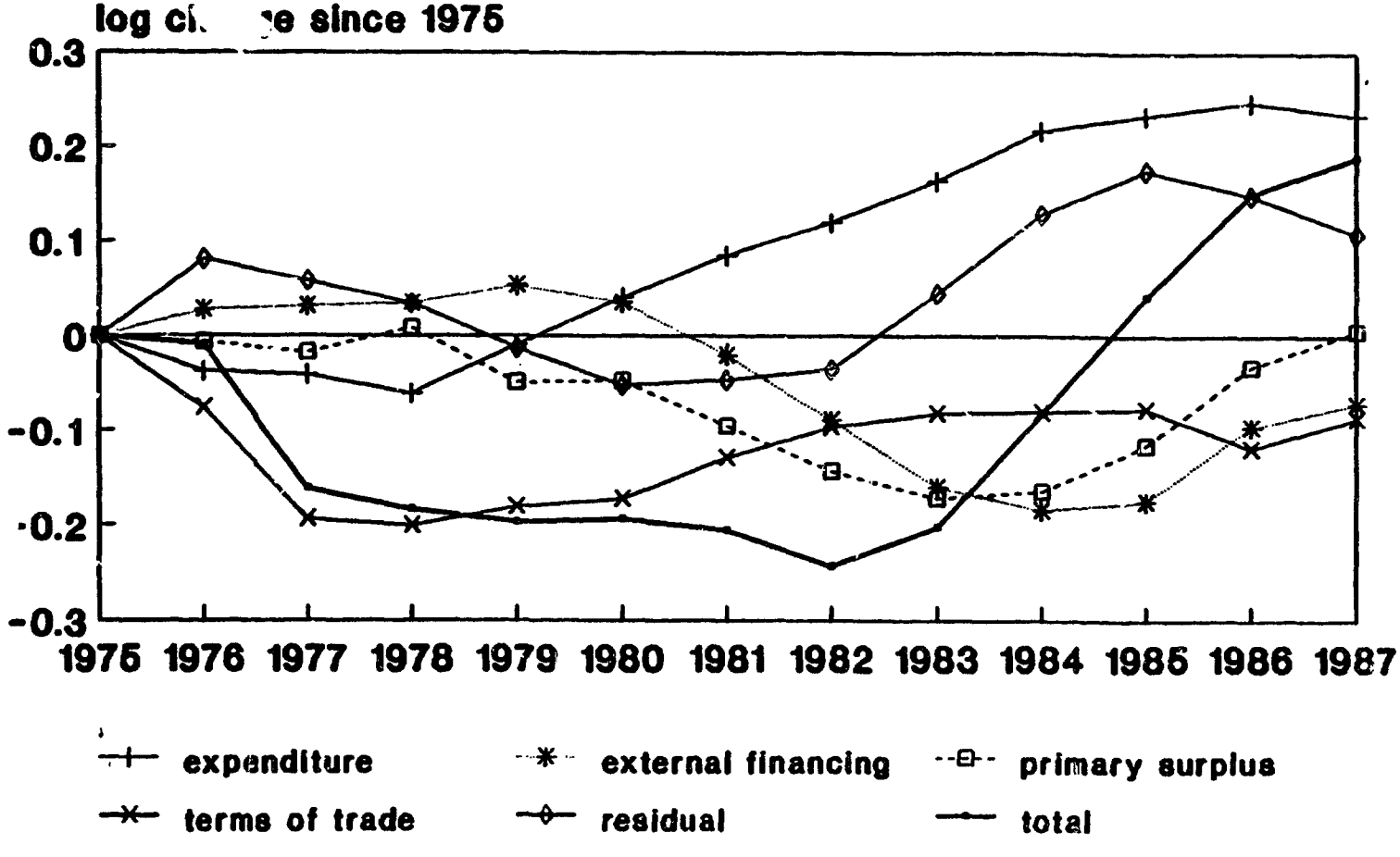
3. Joint simulation of the real exchange rate and resource balance

The models in parts 1 and 2 can be combined to get an idea of the role that fiscal variables played in determining the real exchange rate through their effect on the resource balance. We use the same technique as in the previous sections. The simulated values of the resource balance, alternately varying the primary surplus and public foreign borrowing, are put into the real exchange rate model and simulated. The simulated real exchange rate outcome is compared to that where all variables are fixed, and the difference represents the change in the real exchange rate attributable to changes in the primary surplus and public foreign borrowing, respectively. The unexplained portion of the resource balance is now included under the residual.

Figure 22 shows the decomposition of the real exchange rate including the indirect effects of the government primary surplus and public foreign borrowing. As in the previous section, the effects of changes in the government surplus and changes in financing tend to move together. An externally financed fiscal expansion played a major role in the appreciation of the real exchange

Figure 22

EXCHANGE RATE DECOMPOSITION
Direct and Indirect Effects



rate in the early 1980's, just as the simultaneous reduction of the fiscal deficit and foreign borrowing supported the depreciation after 1984. This exercise can give some insight into what caused some of the most important changes in the real exchange rate. Table 11 shows the changes in the log of the real exchange rate associated with the different exogenous variables in the model. The strong appreciation of 1977 is almost entirely due to the sharp increase in the terms of trade. However, the appreciation was exacerbated by a reduction in the government primary surplus, contrary to what would have been sound policy of increasing the surplus to keep the economy stable. In histories of this period, the attempts of monetary authorities to sterilize the reserve inflows from the

TABLE 11

Exchange Rate Change due to change in:
(depreciation is increase)

	1977	1978	1979	1980	1981	1982
Public External Borrowing	0.004	0.004	0.019	-0.018	-0.056	-0.068
Pub Sector Primary Surplus	-0.011	0.026	-0.057	0.001	-0.048	-0.048
Total Public Expenditure	-0.004	-0.020	0.052	0.050	0.044	0.035
Terms of Trade	-0.118	-0.008	0.020	0.009	0.043	0.033
Overall Residual	-0.023	-0.024	-0.047	-0.039	0.006	0.011
Total	-0.153	-0.022	-0.014	0.003	-0.011	-0.038

	1983	1984	1985	1986	1987
Public External Borrowing	-0.071	-0.024	0.009	0.078	0.025
Pub Sector Primary Surplus	-0.028	0.007	0.049	0.084	0.038
Total Public Expenditure	0.045	0.052	0.016	0.015	-0.014
Terms of Trade	0.015	0.001	0.003	-0.042	0.032
Overall Residual	0.081	0.083	0.047	-0.026	-0.041
Total	0.041	0.120	0.124	0.109	0.039

coffee boom are often stressed. In this model, such monetary policy would work by reducing net public foreign borrowing. We see in Table 11, however, that this was not a major factor in 1977-78 at the height of the coffee boom.

This contrasts with the policy package implemented in 1986 during the second, and smaller, coffee boom. We see that the terms of trade change would have implied an appreciation. However, this was more than offset by the combination of an increased primary surplus with a large reduction in foreign borrowing, so that a real depreciation was achieved.

4. Conclusion

This reduced form model for the real exchange rate and the resource balance has shown that these variables respond importantly to macroeconomic fundamentals such as the fiscal deficit and its financing and the overall level of public spending. This contrasts to the common view in which the real exchange rate is determined by the nominal devaluations chosen by the authorities and the resource balance responds mainly to external developments such as coffee prices. The model shown here is consistent with short-run management of the real exchange rate by the authorities, but in the long run the macro fundamentals are dominant. In particular, the depreciation of the mid-1980's was achieved mainly through a reduction in the public deficit and in public foreign borrowing.

An often overlooked factor that has been highlighted by the model is the shift in the structure of demand associated with the long-run rise in public spending. The evidence indicates that public spending is intensive in tradeables, so that an increase in public spending for a given level of total spending decreases nontradables demand and depreciates the real exchange rate.

The resource balance is explained well by a simple model of the public primary deficit and its financing. A primary deficit will only translate into a resource deficit to the extent that it is externally financed. This suggests that capital mobility is not perfect in Colombia.

This model suggests that desired changes in the real exchange rate and the resource balance need to be supported by fiscal and monetary policy in order to be achieved. Experience of other countries indicates that attempts to influence the real exchange rate through changes in the nominal exchange rate without supporting monetary and fiscal policy will lead only to higher inflation.

IV. SIMULATIONS OF THE FISCAL DEFICIT, REAL EXCHANGE RATE, AND REAL INTEREST RATE

Thus far this paper has taken a partial equilibrium approach to determining the macroeconomic consequences of fiscal deficits. It would also be useful to combine the various models to see the effect of a fiscal deficit on the macroeconomy when external and internal balance is jointly determined. This is done in this section through a model that extends the model of section II to include an external sector, which in turn is more detailed than the reduced form model of the previous section.

The first step in extending the model is to specify some behavioral relations for imports and exports. Most Colombian exports are commodities whose performance is mostly determined by world price movements or international agreements: coffee, oil, gold, nickel, coal, etc. We model here only the exports of manufacturing. Since Colombia has a very small share in the market for these goods, it seems reasonable to suppose that exporters are price-takers. The supply of exports will depend on real income, representing capacity, and the real

exchange rate, representing the relative price of tradable goods to firms. To ensure the stability of the simulation, we constrain the income elasticity of export supply to be one, a restriction that is not rejected by the data. The estimated real exchange rate elasticity is shown in Regression 11.

The price elasticity of export supply is around one, a value that is within the range found by other authors such as Echavarria (1980) and Villar (1984), although somewhat less than that found by Edwards (1985). A variable measuring the degree of import restrictions was also tried, but was not found to be significant.

Regression 11

AR1 : dependent variable is Log Manufactured Exports Volume - Log real GDP

Using 1963 - 1987

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	-2.45596	2.28914	-1.07287	0.294
Log Real Exch. Rate	-1.02085	0.479545	-2.12880	0.044
^RHO	0.683114	0.146062	4.67686	0.000

Equation Summary

No. of Observations =	25	R2= 0.7599 (adj)=	0.7495
Sum of Sq. Resid. =	1.10478	Std. Error of Reg.=	0.219166
Log(likelihood) =	3.51692	Durbin-Watson =	1.69809
Schwarz Criterion =	0.298042	F (1, 23) =	72.7893
Akaike Criterion =	1.51692	Significance =	0.000000

Autocorrelation Estimation Summary

Initial Rho(1) =	0.00030	Final Rho(1) =	0.68311
Std Error of Rho(1) =	0.14606	t-value (sig) =	4.677 (0.000)

R-Squared based on transformed (differenced) model = 0.28040

Convergence at iteration 5

Imports are divided into three categories that are modelled separately. Consumption imports are assumed to depend on the real exchange rate and the volume of private consumption. Intermediate imports depend on the real exchange rate and the level of GDP. Capital goods imports depend on the real exchange rate and the level of private investment. In addition, we include a subjective index of trade restriction that is intended to capture policy shifts from free to restricted access to imports. The elasticities of all 3 types of imports with respect to their activity variables are constrained to be one; this restriction is not rejected by the data.

The results are shown in Regressions 12, 13, and 14. Both the real exchange rate and the index of trade liberalization are strongly significant in the consumption goods and intermediate goods import equations. In the equation for capital goods imports, the real exchange rate is significant but not the trade liberalization index. This may reflect a trade regime in which there are relatively fewer restrictions on capital goods imports.

Regression 12

REGRESS : dependent variable is Log Capital Gds. Imports Volume -
Log real Private Investment

Using 1970 - 1983

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	-14.3363	1.78165	-8.04666	0.000
Log Real Exch. Rate	2.00960	0.351467	5.71776	0.000
Log Trade Lib. Index	0.252613	0.221240	1.14181	0.278

Equation Summary

No. of Observations =	14	R2= 0.7529 (adj)=	0.7080
Sum of Sq. Resid. =	0.200624	Std. Error of Reg.=	0.135050
Log(likelihood) =	9.85251	Durbin-Watson =	1.69553
Schwarz Criterion =	5.89392	F (2, 11) =	16.7593
Akaike Criterion =	6.85251	Significance =	0.000458

Regression 13

REGRESS : dependent variable is Log Consumption Imports Volume - Log real Private Consumption

Using 1970 - 1983

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	-15.4536	1.68140	-9.19086	0.000
Log Real Exch. Rate	1.42393	0.331692	4.29294	0.001
Log Trade Lib. Index	0.647158	0.208792	3.09954	0.010

Equation Summary

No. of Observations =	14	R2= 0.7105	(adj)= 0.6578
Sum of Sq. Resid. =	0.178683	Std. Error of Reg.=	0.127452
Log(likelihood) =	10.6633	Durbin-Watson =	2.08740
Schwarz Criterion =	6.70467	F (2, 11) =	13.4968
Akaike Criterion =	7.66326	Significance =	0.001095

Regression 14

REGRESS : dependent variable is Log Imports of Interm. Volume - Log real GDP

Using 1970 - 1983

Variable	Coefficient	Std Err	T-stat	Signf
^CONST	-13.5363	1.46243	-9.25604	0.000
Log Real Exch. Rate	1.30010	0.288494	4.50650	0.001
Log Trade Lib. Index	0.539991	0.181600	2.97352	0.013

Equation Summary

No. of Observations =	14	R2= 0.7187	(adj)= 0.6675
Sum of Sq. Resid. =	0.135172	Std. Error of Reg.=	0.110853
Log(likelihood) =	12.6167	Durbin-Watson =	1.93907
Schwarz Criterion =	8.65812	F (2, 11) =	14.0508
Akaike Criterion =	9.61671	Significance =	0.000935

We embed these equations and the other behavioral equations from Part II in a complete accounting framework.[16] To solve the model, we specify a target inflation rate and assume that money financing of the deficit is set at a level to achieve this target. External and domestic borrowing by the public sector are specified exogenously. The model then solves for the equilibrium real interest rate and real exchange rate to clear the market for domestic credit and the domestic goods market, respectively. We will use the model to perform policy simulations over the period 1990-94, first solving for a baseline simulation and then solving for changes in the endogenous variables when a given policy changes.

For a given inflation rate, we can present the model as two equilibrium relations between the real interest rate and the real exchange rate, as shown in figure 23. The equilbrium for the goods market implies an inverse relationship between the real interest rate and the real exchange rate (where a real appreciation is defined as an increase in the real exchange rate). An increase in the real interest rate decreases aggregate demand because it decreases investment. To restore goods market equilibrium, we need a real depreciation, which shifts demand away from imports towards domestic goods, and shifts supply away from domestic goods towards manufacturing exports.

The credit market equilbrium, on the other hand, implies a positive relationship between the real exchange rate and the real interest rate. A real appreciation increases the demand for private investment because it lowers the relative price of import-intensive capital goods. This increases credit demand, which must be offset by a rise in the real interest rate.

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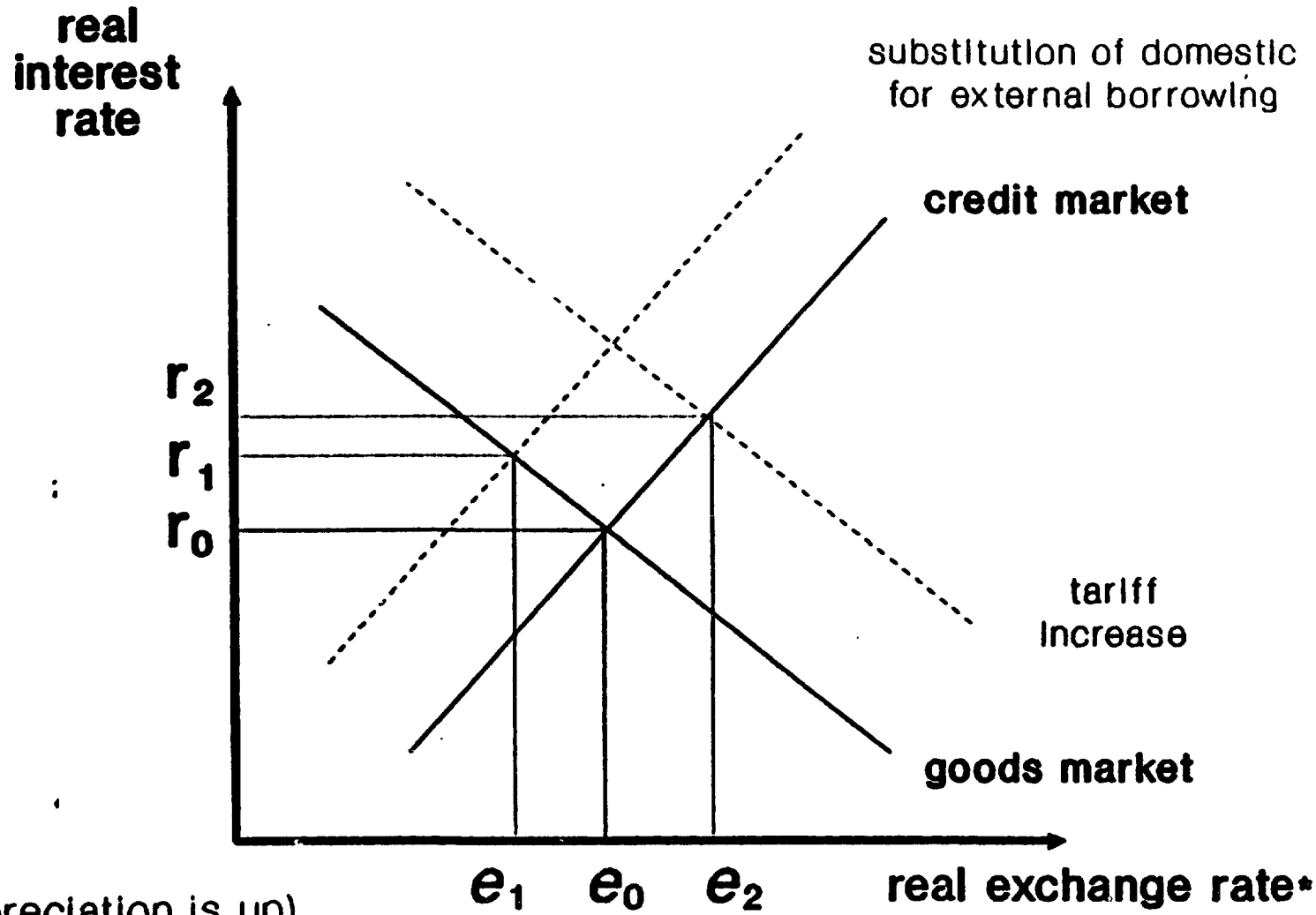
[16]The accounting framework is described in more detail in Easterly, Hwa, Kongsamut, and Zizek (1989). The model of this section is a more detailed and re-estimated version of the model of that paper.

Figure 23



* (appreciation is up)

The first simulation performed with this model is a substitution of domestic borrowing for external borrowing, with the deficit remaining unchanged. The ever more restricted availability of external credit makes this simulation highly relevant for Colombia; as noted in the first section, such substitution was already beginning to take place in 1987-89. In terms of figure 23, this simulation is equivalent to a shift upward in the credit market equilibrium, since higher public domestic borrowing will require a higher real interest rate other things equal. As shown in Table 12, the combination of decreased external financing and increased domestic borrowing results in a real depreciation and an increase in the real interest rate (as predicted by figure 23) in the initial years of the period. The real depreciation is necessary to redirect net spending away from net imports as the real counterpart to the reduced capital inflow. The higher real interest rate decreases private investment. Since domestic debt carries a higher real interest rate than external public debt, the shift from external to domestic financing worsens public saving. Since the deficit is assumed unchanged, the lower public saving means that public investment must fall.

The fall in public and private investment lowers growth in the outer years of the simulation. This fall in output results in some modest real appreciation compared to the base case in 1993-94. The combination of the fall in output and real depreciation slows import growth. The ratio of external debt to GDP falls, but total public debt remains roughly unchanged.

This simulation shows the dangers of shifting towards domestic finance when external finance is reduced. The crowding out of private investment, adverse fiscal impact, and lower growth suggest this policy is inferior to

Table 12

Differences from Base Case
Substituting domestic debt financing for external financing
Ratios to GDP (unless otherwise indicated)

	1990	1991	1992	1993	1994
GDP Growth Rate	0.00%	-0.14%	-0.29%	-0.39%	-0.41%
Investment Growth Rate	-0.26%	-3.25%	-3.02%	0.31%	-1.09%
Privat_	-2.40%	-1.15%	-0.74%	-0.99%	-0.36%
Public	-0.26%	-3.25%	-3.02%	0.31%	-1.09%
GDP per capita Growth Rate	0.00%	-0.14%	-0.29%	-0.39%	-0.41%
Consumption per capita growth rate	0.13%	0.03%	-0.15%	-0.34%	-0.38%
Gross Investment/GDP	-0.26%	-0.59%	-0.80%	-0.84%	-0.89%
Domestic Savings/GDP	-0.05%	-0.14%	-0.22%	-0.29%	-0.33%
National Savings/GDP	-0.06%	-0.12%	-0.16%	-0.17%	-0.16%
Private Investment/GDP	-0.27%	-0.38%	-0.43%	-0.51%	-0.51%
Private Consumption/GDP	0.05%	0.14%	0.22%	0.29%	0.33%
Private Savings/GDP	0.01%	0.16%	0.22%	0.24%	0.26%
Private Resource Balance/GDP	0.28%	0.55%	0.65%	0.76%	0.77%
Public Investment/GDP	-0.01%	-0.21%	-0.37%	-0.33%	-0.38%
Public Savings/GDP	-0.06%	-0.26%	-0.38%	-0.41%	-0.42%
Public Revenues/GDP	-0.02%	-0.03%	-0.04%	-0.04%	-0.04%
Public Expenditures/GDP	0.06%	0.03%	-0.04%	0.03%	-0.01%
Public Deficit/GDP	0.06%	0.07%	0.00%	0.07%	0.03%
MLT External Financing	-0.97%	-0.91%	-0.86%	-0.81%	-0.76%
(External Financing availability)	0.01%	0.01%	0.01%	0.01%	0.01%
ST External Financing	0.00%	0.00%	0.00%	0.00%	0.00%
Domestic financing-financial system	1.03%	0.96%	0.85%	0.86%	0.78%
From Banco de la Republica	0.21%	0.19%	0.11%	0.03%	0.04%
From Rest of Financial System	0.82%	0.76%	0.74%	0.83%	0.74%
Domestic financing-private sector	0.03%	0.02%	0.01%	0.01%	0.01%
Residual	0.00%	0.00%	0.00%	0.00%	0.00%
Real Exchange Rate Depreciation(-)	-0.67%	-0.57%	-0.14%	0.33%	0.23%
Domestic Inflation	0.00%	0.00%	0.00%	0.00%	0.00%
Exchange Rate Depreciation	0.67%	0.69%	0.17%	-0.39%	-0.27%
Nominal Interest Rate	1.92%	2.70%	3.02%	3.46%	3.38%
Real Interest Rate	1.54%	2.17%	2.46%	2.83%	2.79%
Loan Rate	2.39%	3.35%	3.75%	4.29%	4.20%
Real Loan Rate	1.91%	2.70%	3.05%	3.52%	3.47%
Government Interest Rate					
Stock of M1/GDP	-0.10%	-0.13%	-0.13%	-0.14%	-0.12%
Stock of Quasi-money/GDP	0.46%	0.67%	0.78%	0.92%	0.94%
Stock of credit to private sector/GDP	-0.28%	-0.63%	-0.92%	-1.21%	-1.46%
Export Growth Rate	0.25%	0.14%	-0.06%	-0.22%	-0.20%
Growth rate manufacturing exports	0.76%	0.47%	-0.15%	-0.75%	-0.67%
Exports/GDP	0.17%	0.34%	0.42%	0.39%	0.39%
Import Growth Rate	-1.02%	-1.09%	-0.68%	-0.09%	-0.22%
Growth rate intermediate imports	-0.89%	-0.90%	-0.48%	0.04%	-0.11%
Growth rate private capital imports	-3.55%	-2.30%	-1.03%	-0.30%	0.13%
Growth rate private cons imports	-0.90%	-0.86%	-0.38%	0.19%	0.00%
Tax Rate on Imports	0.00%	0.00%	0.00%	0.00%	0.00%
Imports/GDP	-0.06%	-0.12%	-0.16%	-0.16%	-0.17%
Current Account Deficit (in US$mill)	-88.75	-213.79	-303.62	-336.46	-385.45
Current Account Deficit/GDP	-0.20%	-0.47%	-0.64%	-0.68%	-0.73%
Net International Reserves (US$mill)	-58.85	-124.72	-169.24	-176.46	-193.63
Net Reserves (in months imports)	0.00	0.00	0.00	0.00	0.00
Total External Debt/GDP	-0.70%	-1.30%	-1.92%	-2.60%	-3.15%
Public Debt/GDP	0.32%	0.45%	0.31%	0.06%	-0.22%

one of reducing the deficit by an amount comparable to the reduction in external financing.

The second simulation is one where tariff revenues are increased by raising the tax rate on imports (Table 13). As described earlier, this was actually one means of improving the fiscal balance in Colombia during 1985-89. In terms of figure 23, this is equivalent to shifting out the goods market equilibrium curve--a tariff increase increases demand for domestic goods, which requires a real appreciation to redirect demand towards imports. The fiscal deficit is assumed to remain roughly unchanged, so that the increase in tariff revenues is accompanied by an equivalent rise in public investment. We see in the first year of the simulation, the prediction of figure 23 is confirmed--the real exchange rate appreciates and the real interest rate increases. The increased real interest rate decreases private investment, but this is offset by the rise in public investment financed by the additional tariff revenues. The growth rate of both imports and exports falls--the former because of the tariff increase (not fully offset by the real appreciation) and the latter because of the appreciation itself. Thus, in the first year of the program the effect of the tariff increase both crowds out private investment and leads to closing of the economy.

However, if the tariff revenues are indeed used to finance public investment, the effect in the outer years is more favorable. The higher public investment raises growth, which leads to slight real depreciation in 1991-94. The real interest rate also falls because of the increase in output in the outer years. This suggests that the effect of a tariff increase is crucially dependent on how the additional resources are used--if used for investment the initial negative effect can be mitigated through higher growth. Of course, the higher

Table 13

CASE OF INCREASING IMPORT TARIFFS IN 1990

Differences from Base Case

	1990	1991	1992	1993	1994
GDP Growth Rate	0.00%	0.33%	0.32%	0.34%	0.35%
Investment Growth Rate	3.57%	0.24%	0.55%	0.39%	0.35%
Private	-0.67%	1.04%	0.73%	0.65%	0.54%
Public	11.34%	-1.01%	0.67%	-0.07%	-0.13%
GDP per capita Growth Rate	0.00%	0.33%	0.31%	0.33%	0.34%
Consumption per capita growth rate	-0.76%	0.23%	0.24%	0.32%	0.35%
Gross Investment/GDP	0.47%	0.47%	0.52%	0.54%	0.56%
Domestic Savings/GDP	0.38%	0.47%	0.52%	0.55%	0.57%
National Savings/GDP	0.54%	0.61%	0.67%	0.70%	0.72%
Private Investment/GDP	-0.21%	-0.11%	-0.05%	-0.01%	0.02%
Private Consumption/GDP	-0.38%	-0.47%	-0.52%	-0.55%	-0.57%
Private Savings/GDP	-0.02%	0.06%	0.11%	0.15%	0.18%
Private Resource Balance/GDP	0.19%	0.17%	0.17%	0.16%	0.16%
Public Investment/GDP	0.68%	0.58%	0.57%	0.55%	0.54%
Public Savings/GDP	0.56%	0.55%	0.56%	0.55%	0.54%
Public Revenues/GDP	0.42%	0.42%	0.42%	0.41%	0.41%
Public Expenditures/GDP	0.54%	0.46%	0.45%	0.43%	0.42%
Public Deficit/GDP	0.12%	0.04%	0.03%	0.01%	0.01%
MLT External Financing	-0.06%	-0.05%	-0.03%	-0.03%	-0.03%
(External Financing availability)	-0.06%	-0.05%	-0.03%	-0.03%	-0.03%
ST External Financing	0.01%	0.00%	0.01%	0.00%	0.00%
Domestic financing-financial system	0.18%	0.10%	0.06%	0.06%	0.04%
From Banco de la Republica	0.18%	0.10%	0.06%	0.06%	0.04%
From Rest of Financial System	0.00%	0.00%	0.00%	0.00%	0.00%
Domestic financing-private sector	0.00%	-0.01%	0.00%	0.00%	0.00%
Residual	0.00%	0.00%	0.00%	0.00%	0.00%
Real Exchange Rate Depreciation(-)	4.97%	-0.60%	-0.34%	-0.26%	-0.21%
Domestic Inflation	0.00%	0.00%	0.00%	0.00%	0.00%
Exchange Rate Depreciation	-6.05%	0.72%	0.41%	0.33%	0.25%
Nominal Interest Rate	0.67%	0.09%	-0.24%	-0.49%	-0.64%
Real Interest Rate	0.54%	0.07%	-0.20%	-0.40%	-0.53%
Loan Rate	0.64%	0.11%	-0.30%	-0.61%	-0.79%
Real Loan Rate	0.37%	0.09%	-0.24%	-0.50%	-0.65%
Stock of M1/GDP	-0.06%	0.00%	0.01%	0.01%	0.01%
Stock of Quasi-money/GDP	-0.07%	-0.20%	-0.26%	-0.29%	-0.30%
Stock of credit to private sector/GDP	-0.15%	-0.30%	-0.36%	-0.43%	-0.45%
Export Growth Rate	-1.71%	0.32%	0.25%	0.18%	0.16%
Growth rate manufacturing exports	-5.30%	0.97%	0.69%	0.64%	0.58%
Exports/GDP	-1.17%	-1.09%	-1.08%	-1.06%	-1.05%
Import Growth Rate	-1.52%	-0.30%	-0.01%	0.09%	0.17%
Growth rate intermediate imports	-3.99%	-0.47%	-0.14%	-0.04%	0.06%
Growth rate private capital imports	-6.54%	-0.21%	0.01%	0.07%	0.09%
Growth rate private cons imports	-4.76%	-0.68%	-0.27%	-0.12%	0.00%
Tax Rate on Imports	8.00%	8.00%	8.00%	8.00%	8.00%
Imports/GDP	-1.08%	-1.09%	-1.08%	-1.07%	-1.06%
Current Account Deficit (in US$mill)	9.5	-29.7	-48.2	-59.8	-65.2
Current Account Deficit/GDP	-0.07%	-0.14%	-0.15%	-0.16%	-0.16%
Net International Reserves (US$mill)	-88.1	-117.8	-132.3	-141.4	-146.4
Net Reserves (in months imports)	0.00	0.00	0.00	0.00	0.00
Total External Debt/GDP	-1.96%	-1.80%	-1.72%	-1.68%	-1.66%
Public Debt/GDP	-1.56%	-1.37%	-1.29%	-1.26%	-1.25%

tariffs lead to some distortion of resource which would negatively affect growth, which is not captured by this model. And if the higher tariff revenues are not used to finance investment--as they were not in 1985-89--then the effect on both openness and growth will be unambiguously negative.

VI. CONCLUSION

The management of fiscal deficits and their financing in Colombia has been generally sound. The first section showed how episodes of loose fiscal policy have been minor compared to other Latin American countries. The near-crisis of the early 1980's was addressed in a timely way through a sharp fiscal adjustment. An analysis shows this adjustment to have been a combination of good luck and fundamental policy changes, with more emphasis on the latter. The means of fiscal adjustment chosen were sometimes suboptimal from the standpoint of long-run growth, which will eventually require some fiscal reform to reverse some of the measures implemented during 1985-89.

The analysis of this paper shows a close relationship between the means of financing of the fiscal deficit and macroeconomic outcomes in Colombia. In Section III, a simulation model traces how money-financed and domestic debt-financed fiscal deficits translate into inflation and the real interest rate. Roughly speaking, a debt-financed deficit increase of about 1 percent of GDP translates into a real interest rate increase of 3 to 5 percent, while a money-financed deficit increase of about 1 percent translates into 15 percentage points additional inflation. In Section IV, we trace the relationship between externally-financed fiscal deficits and the real exchange rate and find that a good deal of the changes in the real exchange rates over 1975-87 are attributable to fiscal policy. In Section V, these models are combined to show how the

external versus domestic debt financing affects the simultaneous determination of the real exchange rate and real interest rate.

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